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From Persuasion to Negotiation in Health Promoting Technology

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Dedication

This thesis is dedicated to the memory of Eddie Appleby.

I simply cannot put into words how wonderful a man Eddie was. He was immensely strong and immeasurably kind. His laugh and his lust for life were infectious. Without him I would have been half the person I am today. He showed me the importance of making the most out of life and taught me everything I know about having fun along the way.

And then some.

I miss you Brother.

Abstract

Over recent years, designing technologies to promote health-related behavioural change has been an area of growing interest in HCI. Given the prevalence of self-monitoring and social facilitation in emerging designs, the assumption appears to be that increasing an individual's awareness of his or her behaviour and the behaviour of others will promote behavioural change. This thesis argues that while this is true to some extent, this represents a somewhat naive view of how individuals come to make decisions regarding their health-related behaviours. Three qualitative studies within distinct health domains illustrate the complex nature of health-related behavioural change.

Weight Management was an inherently social activity, albeit subject to selective disclosure and incremental participation. Individuals were generally motivated by appearance rather than health, implementing change based on exposure and orientation to alternative strategies. In *Families at Risk*, caregivers were highly motivated by a desire to safeguard the health of their children but were restricted by a lack of financial and strategic resources. Lack of trust and a transient community contributed to social isolation, thus inhibiting opportunities for collaboration. In *Cardiac Rehabilitation*, behavioural change efforts were prompted by an acute health crisis and guided by health professionals. However, behavioural change efforts were sometimes restricted by a desire to return to normal, tensions arising when what was considered normal was composed of risk behaviours. Family involvement varied greatly, ranging from disregard to facilitating change, and a desire for independence and ownership of the rehabilitation sometimes restricted the active involvement of peers.

Informed by the findings of these studies this thesis highlights the strengths and limitations of current technological approaches to promoting behavioural change, provides implications for design, and supported by the sociomedical literature, identifies alternative avenues of technological innovation. The thesis reflects on technology's role in health-related behavioural change and considers associated ethical implications. Overall, the main contribution of this thesis is a reframing of the problem of promoting health-related behavioural change as more than a matter of behavioural awareness and personal motivation. While it is understandable that technologists would look to the clinical domain to inform initial investigations in this area, this thesis argues that technologists should be cautious about blindly adopting its prescriptive paradigm. As an alternative to persuasion, this thesis offers negotiation as a potential model for future innovations in this area.

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[1] In alphabetical order so as to avoid any diva-like tantrums. You know who you are!

Author's Declaration

I certify that I am responsible for the work submitted in this thesis, that the original work is my own except as specified in acknowledgements, and that neither the thesis nor the original work contained therein has been submitted to this or any other institution for a higher degree.

Three of the studies that are presented in this thesis are the results of collaborations. In Chapter 4, the motivational issues survey was carried out with Louise Barkhuus, and Shakra was designed, developed and evaluated in a collaboration between members of the Glasgow and Bristol Equator groups. In Chapter 7, the Families at Risk study was performed in collaboration with Katie Siek, an Associate Professor in the Computing Science Department at the University of Colorado at Boulder.

The author has attempted to make clear her own contribution and that of her collaborators in the corresponding chapters.

Associated Publications

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Ian Anderson, Julie Maitland, Scott Sherwood, Louise Barkhuus, Matthew Chalmers, Malcolm Hall, Barry Brown and Henk Muller (2007) Shakra: Tracking and Sharing Daily Activity Levels with Unaugmented Mobile Phones. ACM Mobile Networks and Applications Journal (MONET), Special Issue on Pervasive Healthcare, 12(2-3), pp 185-199.

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Julie Maitland, Scott Sherwood, Louise Barkhuus, Ian Anderson, Malcolm Hall, Barry Brown, Matthew Chalmers, and Henk Muller (2006) Increasing the Awareness of Daily Activity Levels with Pervasive Computing. In Proceedings of Pervasive Computing Technologies for Healthcare 2006, Innsbruck, Austria, IEEE.

Julie Maitland and Matthew Chalmers (2006) Collaborative e-Health Systems. In Proceedings of the 9th Human- Centred Technology Postgraduate Workshop: Designing for Collaborative as well as Individualised Environments (HCT 2006). Sussex, U.K.

Julie Maitland (2006) Crossing the Social Network Boundary. In Proc. 'Mobile Social Software: Realizing Potential, Managing Risks' workshop, ACM Conference on Human Factors in Computing (CHI'06). Montreal, Canada.

1 Introduction

The problem of how to promote health-related behavioural change is a relatively new concern for the HCI community. Three fields in particular have contributed to the development of health-related behavioural change as an active area of research—Ubiquitous Computing, Persuasive Computing and Pervasive Health. While Ubiquitous Computing has been primarily focussed on developing sensor technology to monitor and infer human behaviour, Persuasive Computing focuses on designing technology to change human attitudes and behaviour. Pervasive Health very often involves elements of both Ubiquitous and Persuasive Computing, with an explicit goal of increasing the availability and scope of healthcare. From these fields many innovative and engaging applications have been developed. We refer to the genre of systems being developed as Everyday Behavioural Change Technology; non-clinical applications that have been designed to promote health-related behavioural change.

This thesis complements the technological advances in this field with an exploration of everyday health-related behavioural change as experienced by populations who are

currently, or are at risk of, experiencing conditions[2] associated with physical inactivity and poor dietary intake.

1.1 Motivation and Objectives

Over recent years many novel and innovative technologies have emerged from academic and commercial domains aimed at encouraging changes in physical activity levels and, to a lesser extent, dietary intake. As will be discussed in Chapter 3, these technologies commonly combine self-monitoring with playful elements of a social nature. Apart from the obvious goal of promoting health-related behavioural change, the overall motivation behind the development of everyday behavioural change technologies can be explained by considering some of the underlying objectives of the Pervasive Health research community. In the same way that the Internet eases access to information, technology can be used to increase access to healthcare. Particularly relevant to the application area of everyday behavioural change technology, is the goal to "help integrate healthcare more seamlessly into everyday life" [21].

When considered in relation to the goals of Pervasive Health, there are two distinct challenges to be addressed by designers of everyday behavioural change technology. The first is concerned with how to encapsulate the mechanics of promoting behavioural change, and the second with the integration of such technology into everyday life. While much attention has been paid to the adequate representation of clinical aims and behavioural change techniques, there has been relatively little investigation into what is required to integrate those aims and techniques seamlessly into everyday life. Does porting a behavioural change programme onto a mobile phone equate to seamless integration? We suggest not. Life is not a behavioural change programme, and without considering the broader context in which health-related behaviours occur it would appear that only one half of the challenge of everyday behavioural change technology is being addressed.

The author's initial interest in exploring this particular application area stemmed from a combination of studying within a research group with expertise in social and ubiquitous computing, and the author's interest in health[3]. Reflecting this, we were initially focussed on exploring the social dynamics of health-related behavioural change. As we became

[2] E.g., symptoms or diagnoses
[3] Prior to studying Computer Science, the author worked as a Registered Nurse.

more familiar with the problem of promoting health-related behavioural change, we became aware of an underlying assumption that appeared to inform the design of many of the emerging designs of everyday behavioural change technology. Given the prevalence of self-monitoring and social facilitation in emerging designs, the assumption appears to be that increasing one's awareness of one's behaviour and the behaviour of others will promote behavioural change. While this is true to some extent, we suggest that this represents a somewhat naïve view of how individuals come to make decisions regarding their health and health-related behaviours. Reflecting on this observation, we expanded the focus of our investigations to also consider the experience and practice of implementing everyday health-related behavioural change, from hereon in referred to as everyday behavioural change.

As will be seen in Chapter 3, the majority of the HCI community takes a generic view of the problems and potential solutions to physical inactivity and poor dietary intake. That is, they are most often considered in isolation from surrounding health and social contexts. If this thesis were to contain a hypothesis it would be that individuals' lifestyle-related conditions and social environments should be considered in the design of applications intended to promote health-related behavioural change. However, the work in this thesis takes an exploratory, rather than hypothesis-driven, approach. The overall research goals of this thesis are the investigation of everyday behavioural change, and the exploration and mapping out of a design space of appropriate technological interventions.

1.2 Research Approach

As with the focus of this thesis, the approach that was taken in order to carry out the research evolved over time as we became aware of the merits and limitations of our existing practice. We initially used a traditional HCI approach, designing and developing a prototype application, and then performing a pilot-study to evaluate user responses and reactions to the design concept. As discussed in Chapter 4, our initial prototype actually embodied the aforementioned approach of self-monitoring and social facilitation that we have just suggested to be naïve. Furthermore, as with most everyday behavioural change applications being developed in HCI at that time, pilot-study participants were relatively well individuals. For the subsequent studies we sought to explore the broader context of health-related behavioural change within specific health domains: weight management, cardiac rehabilitation, and families at risk. We also employed a less technocentric approach

to our investigations, employing qualitative enquiry to investigate the problem space from the perspective of the study participants.

Our probes into the everyday practice and experience of health-related behavioural change were semi-structured interviews. The interviews were analysed using techniques borrowed from symbolic interactionism; the findings of each study were then used to highlight areas of opportunity and constraint for existing and future technological interventions. The discussions that surround the findings of the studies draw from the relevant literature from the technological and sociomedical domains. Details of the theoretical approach that informed this research, and the methods employed to carry out this research, are discussed further in Chapter 5.

1.3 Research Outcomes

The main outcome of this research is the insight gained into health and everyday behavioural change as experienced by groups of people affiliated by their socioeconomic status (families at risk), medical history (cardiac rehabilitation) or self-perception (weight management). The findings of the studies prompts us to suggest that everyday behavioural change should be viewed as a matter of compromise; the main elements being clinical guidelines, perceptions of health and health-related behaviours, competing values, resources, and self-determination. Taking such a perspective allows us to acknowledge that individuals evaluate recommendations with regard to the competing values and constraints of their everyday lives, and then harness the resources available to them to implement the degrees of change that they determine are appropriate. In addition to the critique of current approaches and the identification of areas of opportunity and constraint, the empirical findings of each study inform a broader discussion and consideration of technology's role in promoting health-related behavioural change.

Overall, the main contribution of this thesis is a reframing of the problem of promoting health-related behaviour as more than a simple matter of behavioural awareness and personal motivation. While it is understandable that technologists would look to the clinical domain to inform initial investigations in this area, this thesis argues that technologists should be cautious about blindly adopting its prescriptive paradigm. As an alternative to persuasion, this thesis offers negotiation as a potential model for future innovations in this area.

1.4 Thesis Walkthrough

This thesis is composed of three parts that reflect different stages in the construction of an argument for negotiation as a model for future health promoting technologies. The first part of the thesis, which includes this chapter, sets the scene for the work that forms the main body of this thesis.

- Chapter 2 presents an overview of the problem behaviours of concern and related models of health-related behavioural change. It provides the reader with a sociomedical perspective of the problem area, which simultaneously explains and raises questions about the current approach being taken in HCI.

- This approach is presented in Chapter 3, which explores the concept of everyday behavioural change technology through a critical review of the existing systems and dominant paradigms.

- Chapter 4 presents our first investigations that explored the problem of motivating physical activity. It is included in this initial part of the thesis because it embodied the mainstream HCI approach discussed in Chapter 3. It concludes with a reflection on the methodological strengths and shortcomings of the initial investigations, and explains the reorientation that directs the remainder of the thesis.

The second part then details the three core studies that explore the social dynamics of health-related behavioural change and further illustrate the strengths and limitations of current approaches.

- Chapter 5 presents the theoretical and analytical perspective that informed the remainder of the thesis, and introduces the methods employed to carry out each of the studies. It also introduces the interpretive framework that is used to structure the findings of the studies in the following three chapters. The studies are not presented chronologically. As will be discussed in Chapter 5 there was a degree of overlap between them all, so instead they are presented in an order that will hopefully best illustrate the argument being put forward by this thesis.

- In Chapter 6 the findings of the Weight Management study highlight the social and subjective nature of weight management, while outlining the information disclosure practices employed.

- Chapter 7 provides a stark contrast to the everyday nature of weight management in the Families at Risk study, in which scope for collaboration was restricted due to social isolation and lack of trust, and scope for behavioural change was restricted by limited resources.

- Chapter 8 provides further contrast with the findings of the Cardiac Rehabilitation study, which saw individuals undergo a period of supervised guidance after which they determined the extent of any further behavioural change, considering health benefits alongside how change would affect their everyday life.

- The end of Chapters 6 to 8 present a discussion of the implications of such findings for HCI, alongside a critique of how current technology does or does not fit with the practices and perspectives of the study participants.

The final part then draws from the findings of studies to formulate an argument for an alternative approach to promoting positive health-related behaviours: offering negotiation as a possible strategy.

- Chapter 9 provide an analysis of the problem of everyday behavioural change at three levels: firstly it provides an overview of everyday behavioural change as informed by the three studies presented in Part II. It then revisits the implications for research and design from the three studies, to identify areas of commonality and divergence and to further discuss the opportunities and challenges that might be topics of future work. Finally, and forming the capstone of the previous work, the problem of promoting everyday behavioural change is reframed as a matter of negotiation rather than persuasion, exploring the notion of negotiation and outlining a framework for future investigation.

- To conclude, Chapter 10 reviews the thesis and its contributions, before suggesting avenues of future research that are inspired by the contributions and limitations of this work.

2 Health-Related Behaviour and Behavioural Change

The work in this thesis lies at the intersection of several academic disciplines: computer science, social science, and health studies. The purpose of this chapter is to give an overview of the work done in the sociomedical domains; the following chapter will address the emerging technologies being developed within HCI and related communities.

2.1 Introduction

Systems being developed to promote health-related behavioural change, by their very nature demand an interdisciplinary perspective. Although a relatively new area of research within HCI, it is a well-established topic of investigation that spans the medical, psychological and sociological domains. As a result, there is a multitude of behavioural change techniques, programmes, strategies and tools that can inform and guide the development of appropriate technological contributions to this problem space.

The next section will provide an overview of the 'problem' health-related behaviours that are the focus of this work: physical inactivity and poor dietary intake. In Section 2.3 we will review the dominant models of health-related behavioural change that inform physical activity and dietary behavioural change interventions and programmes. Section 2.4 then considers individual behavioural change techniques, their effectiveness, and the current use of technology within clinical behavioural change interventions.

2.2 The Problem Behaviours

Over the past century the UK has seen chronic diseases (CDs) overtake infectious diseases as the primary causes of death [83]. Medical advances in the treatment and prophylaxis of infectious diseases have unarguably reduced their mortality rates. However, the subsequently prolonged life expectancy of people since the reduction of infectious disease-related death is one of many factors contributing to the increased mortality rate of chronic diseases. Many conditions fall under the category of CD and include cardiovascular diseases, respiratory diseases, diabetes, obesity and cancer. Other risk factors include genetic and physiological predisposition, environmental exposure to pollutants and carcinogens, and health-related behaviours. The three health-related behaviours of most concern with respect to chronic diseases are dietary intake, physical activity and tobacco use [232]. According to the World Health Organisation [257]:

> ***Five out of the 10*** *leading global disease burden risk factors identified by World Health Report 2002 - high blood pressure, high cholesterol, obesity, physical inactivity and insufficient consumption of fruits and vegetables* ***- are strongly related to diet and physical activity***[4].

In response to what is being referred to as the global epidemic [257] and crisis [232] of CD, efforts are now being made to promote positive change in health-related behaviours. As will be discussed further in Section 2.3, traditional approaches to promoting health-related behavioural change have tended to focus only on the individual [49], which demonstrates the narrow view of behaviour presented in the dominant models of behavioural change. More recently we have seen a shift in attitude that reflects the widely acknowledged external factors that contribute to an individual's health behaviours. In the 2004 government report *Securing Good Health for the Whole Population*, Wanless [249] highlighted the need to engage people in their health while acknowledging the external influences on an individual's decisions regarding health and health-related behaviour:

> *Individuals are ultimately responsible for their own and their children's health and it is the aggregate actions of individuals, which will ultimately be responsible for whether or not such an optimistic scenario as "fully engaged" unfolds. People need to be supported more actively to make better decisions about their own health and welfare because there are widespread, systematic failures that influence the decisions individuals currently make.*

[4] Emphasis added by author.

In the white paper, Choosing Health [83], they elaborate "for individuals, motivation, opportunity and support all matter". In 2007 the Department of Health [190] discussed the "social, psychological, biological and environmental factors" involved in the initiation and maintenance of health behaviours, and stated:

> *Intention to change a behaviour, while a prerequisite of change, can be insufficient to produce sustained change.*

As indicated in the introduction, the work in this thesis considers the problems of physical inactivity and poor dietary intake, and the scope for technological interventions that so far only address individual awareness and motivation (see Chapter 3). The choice of health-related behaviours was partly motivated by the pertinence and close relationship between the two behaviours, but also inspired by the increasing attention that the behaviours are receiving from HCI—as will be discussed in Chapter 3. Before considering technology's current role in physical activity and dietary change, this section presents the problems of low levels of physical activity and poor dietary intake as framed by their recommended guidelines. Section 2.3 will also precede the technological critique with a review of dominant and alternative models of health and behavioural change.

2.2.1 Physical Inactivity

Physical inactivity continues to be a major problem area for public health organisations around the world, despite ongoing awareness-raising campaigns and initiatives. The problem of inactivity is widespread, with the World Health Organisation (WHO) estimating that 60% of the worldwide population do not achieve the minimum recommended levels of activity [258]. Speculated reasons for such persistent inactivity are manifold, and can be found at personal, community, and organisational levels. Post-industrialised society has led to a reduced need for physical activity in our day to day lives [178]. Fairly consistently throughout the Western world participation in leisure-time moderate-intensity activity—generally defined as when a person's heart beat is increased to 55-69% of their maximum heart rate—ranges from 29%-51% [35]. Sociodemographic factors affecting participation rates include age [35], gender [35, 181], socioeconomic status [35], and surrounding environment [118]. On a personal level, by far the most commonly stated barrier to participation in physical activity is lack of time [34, 178]. However, Morris and Choi [178] points out, "there is no evidence to indicate that people who are active have more leisure time available to them than people who are not". They go on to suggest that the overarching problem (on a personal level) is that of self-motivation,

using the following findings from a comparative study of active and inactive older adults as an illustration:

> *Negative dialogue about physical activity is prevalent among older adults, even those who are physically active. The difference between low-active and active people seems to be that active individuals bolster themselves and counter-balance negative thinking and barriers with strong, positive dialogue.*[188]

According to the official UK guidelines for physical activity [82], for general health benefits adults should participate in at least 30 minutes of moderate-intensity physical activity on five or more days of the week. The 30 minutes can be achieved in smaller sessions of 10 minutes or more. In 2007 the American College of Sports Medicine updated their physical activity and public health recommendations. The updated minimum recommendations being:

i. Aerobic activity in bouts of 10 minutes or more for a total of 30 minutes of moderate intensity 5 days a week

    a. Or 20 minutes vigorous intensity 3 days a week

    b. Or a combination of moderate and vigorous intensity 4 days a week

ii. Muscle-strengthening activity twice a week, at least one day apart, incorporating 8-10 exercises using the major muscle groups

In addition to developments in scientific knowledge regarding the benefits and effectiveness of the various types of physical activities, the update was motivated by misinterpretations of the original recommendations:

> *Some people continue to believe that only vigorous-intensity activity will improve their health while others believe that the light activities of their daily lives are sufficient to improve their physical health" [122].*

A grey area for most of the general public is what physical activities are beneficial, and how to determine whether the intensity of the activity is moderate. Moderate activity would, for many people, occur when walking at about 4 miles per hour. It is broadly acknowledged that in addition to the more obvious activities of brisk walking, cycling, jogging, and running, daily lifestyle activities such as housework, gardening, and putting

shopping away are all considered to be valid physical activity; but only when performed for at least 10 consecutive minutes. However, when Intille at al. [133] recently monitored the heart rate of five housekeeping maids, they found relatively low variation in heart rate and the activities were of lower intensity than expected, emphasising the importance of exertion as well as duration and suggesting, "that housekeeping activities contribute less to health outcomes than previously thought".

2.2.2 Poor Dietary Intake

Although there remain areas of confusion with regards to how much of what type of physical activity is considered acceptable, the guidelines for physical activity are relatively straightforward in comparison to the recommended guidelines of what constitutes a healthy diet. UK nutritional guidelines are based on five food groups as illustrated by the Eatwell Plate (Figure 2-1). Unlike the United States Department of Agriculture's (USDA) Food Pyramid, it includes a food group apparently at odds with what is traditionally considered to be a healthy diet, food and drinks high in fat and/or sugar. The UK's Food Standards Agency's (FSA) website does state that the inclusion of such foods is not essential for a healthy diet. It also does not prescribe the number of portions of each food group, instead opting to highlight the necessity of a balanced diet.

The Food Pyramid is arguably the more recognisable nutritional guide of the two. Essentially the nutritional guidelines being conveyed are the same but, as mentioned above, the manner of the delivery is different. The USDA updated the food pyramid in 2005 to emphasise the need for variety by representing the food groups as horizontal stripes as opposed to a building block formation (see Figure 2-2). However, critics suggest that the new design increases the scope for misinterpretation and have questioned the scientific validity of the guidelines [64, 138]. Example areas of concern are the lack of disambiguation between red and white meats, or red meat and beans, and the relatively high level of recommended daily dairy intake. Chiuve and Willett [64] suggest:

> *At its core lies the premise that 'there is no such thing as a good or bad food', which reflects the current USDA policy and, perhaps not incidentally, the mantra of the dominant forces in the US food industry.*

Figure 2-1: The FSA Eatwell Plate

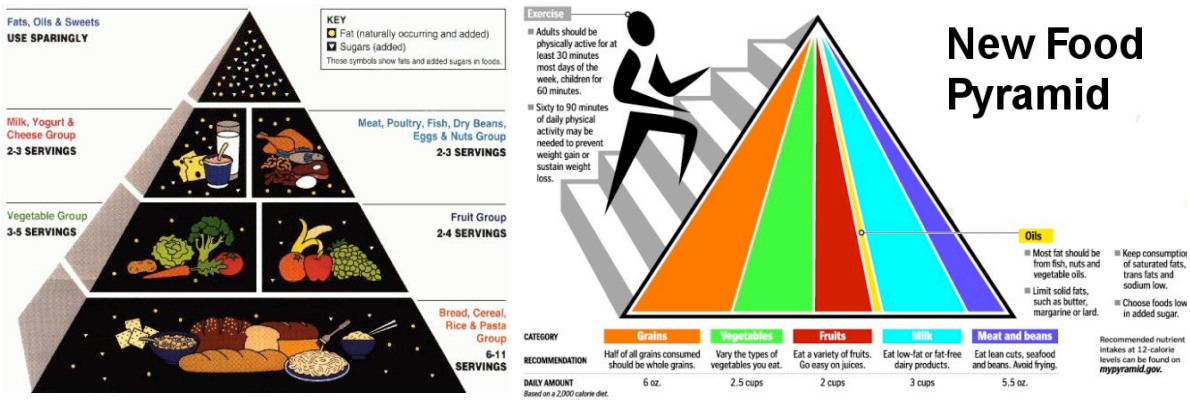


Figure 2-2: The USDA Food Pyramid (left) and MyPyramid (right)

In addition to the alterations already mentioned, physical activity was also introduced through a figure climbing a set of stairs up the side of the pyramid and the updated pyramid has become an interactive tool. Now called MyPyramid, tailored recommendations can be made based on age, gender, and level of physical activity. However, the interactivity of MyPyramid means that it is now essentially a web-based tool. In contrast to the line of thought that web-based information is more widely available than paper-based, this has led to the criticism that the information is now inaccessible to the

people who need it most [64, 138]. Such a critique of the digitisation of nutrition guidelines raises the issue of further aggravating existing health inequalities with the introduction of technology. The 'digital divide', and the potential to further disadvantage vulnerable populations through digital exclusion, are topics that will be revisited throughout this thesis.

Consuming the correct amount of each food group could be considered a target behaviour in itself. Fishbein [97] describes healthy eating as a behavioural category rather than a behaviour per se. Indeed, many dietary change interventions focus on one particular food group; commonly aiming to increase fruit and vegetable intake or reduce fat intake, but also targeting other behaviours such as fibre consumption [150]. Subsequently, due to the complexity of defining dietary intake, it is also relatively difficult to measure. Using self-reported frequency of fruit and vegetable consumption as an indicator for the overall healthiness of dietary intake in Scotland, only 30.1% of survey respondents (n= 6282) were considered to have a healthy diet (by eating fruit and/or vegetables a few times a day) [124]. This study confirmed the findings of previous studies that found that age, gender, and socioeconomic status, were all sociodemographic factors influencing dietary intake [85], as they were for physical activity.

Unlike physical activity, where broader sociodemographic factors are acknowledged but the main focus of interventions remain mostly concerned with increasing the self-motivation of the individual, current dietary change literature advocates a much more integrated approach to promoting change at multiple levels [8, 85]. Figure 2-3 shows Dixon and Paxton's conceptual model of social, economic, and individual determinants of dietary behaviour [85].

Apart from being informative in its own right, the model also is useful for contextualising the argument for looking beyond promoting dietary behavioural change solely at the level of the individual, as articulated by Ammerman at al [8]:

> *Dietary behavior change is inextricably linked to social, environmental, cultural, and individual psychosocial and cognitive factors. Unlike pharmacotherapy, a "single agent" approach to dietary change is neither feasible nor theoretically sound.*

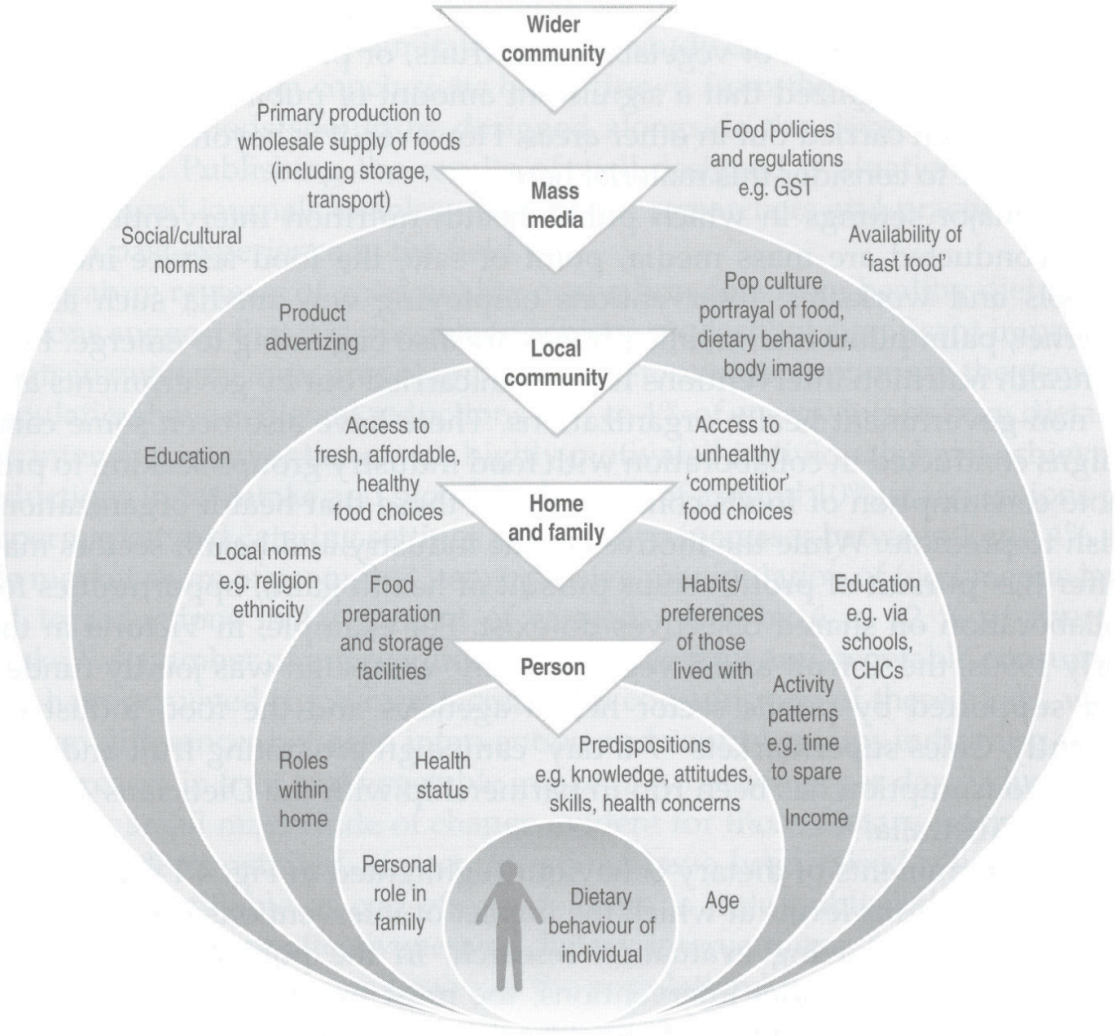


Figure 2-3: Dixon and Paxton's Conceptual Model of Determinants of Dietary Behaviour[5]

2.2.3 Summary

This section has provided an overview of the public health literature and introduced the burden of chronic disease and the contributing problems of physical inactivity and poor dietary intake. The recommended guidelines for physical activity and dietary intake both involve a degree of ambiguity in their interpretation. Updated physical activity guidelines have sought to reduce this degree of ambiguity in the interpretation of the guidelines, but the possibility for misunderstanding remains in the self-assessment of what behaviours contribute to the recommended activity levels. The scientific basis of dietary guidelines has been questioned, and their graphical representation leaves them open to misinterpretation.

[5] This image was published in Behavioural Change: An Evidence-based Handbook for Social and Public Health, C. J. Browning and S. A. Thomas, Page 49, Copyright Elsevier (2005).

We touched on the multi-levelled barriers and approaches to promoting behavioural change that range from the individual to the organisational. While external barriers are acknowledged, the primary barrier of concern to increasing physical activity appears to be the motivation of the individual. Barriers to improving dietary intake are distributed along the individual-organisational spectrum. Thus it has been suggested that health-related behavioural change interventions be targeted accordingly. The following section discusses the various levels of health-related behavioural change in more detail.

2.3 Health-Related Behavioural Change

Reflecting the multileveled influences on health, theories and models of health behaviour and behavioural change can be found at the individual, interpersonal, and community levels. Of the three categories, individual level models are by far the most dominant within traditional behavioural change programmes. Interpersonal and community level models appear less frequently within behavioural change programmes but are central to the ethos of health promotion, rather than behavioural change, which has the broader aim of "enabling people to increase control over, and to improve, their health" [256]. Lee et al. [151] raised the issue of tackling health promotion at an individual and societal level:

> *We can continue to advise individuals about their CVD risk factors, but we also have to acknowledge that deprived and less affluent neighbourhoods have a negative effect on the incidence and prevalence of [Coronary Heart Disease] in its many forms… the benefits of advising patients to participate in exercise and to improve their diet needs to be balanced by the availability of local resources.*

As this thesis is primarily concerned with the social dynamics of peer involvement in health-related behavioural change, we focus on the interpersonal models. However, in view of the dominance of individual level models it is worth starting with a consideration of the strengths and weaknesses of such approaches. A complete review of all models of health-related behaviour and behavioural change is outside the scope of this thesis. Therefore the models included are the most commonly used or illustrative of an alternative approach.

2.3.1 Individual

The most widely accepted and adopted model of Health-Related Behavioural Change is the Transtheoretical Model [199] (TTM). Change within TTM is viewed as a process. The five

stages of change are precontemplation, contemplation, preparation, action and maintenance and are presented in Table 2-1 (adapted from [3, 200]).

Stage of Change	Generic Definition
Precontemplation	No intention of changing with the next six months
Contemplation	Seriously thinking of changing within the next six months
Preparation	Intending to change in the next month
Action	0-6 months after changing
Maintenance	>6 months after changing

Table 2-1: Generic Definitions of Stages of Change

The TTM was originally developed for clinical use with individuals undergoing treatment for addictive behaviours, the idea being that interventions could be tailored to the individual's particular stage of change. Since then the model's creators have offered evidence to suggest its generalisability across additional behaviours [200], including physical inactivity and high-fat dietary intake, and the model has been adopted and used in a multitude of settings other than originally intended.

The TTM, however, is not without its critics. The difference between addiction and lifestyle, for example, is not accounted for when applying an addiction-based model outside its original domain of development. Adams et al. [3] suggest that by focusing solely on the individual, contributing factors such as gender and income are consequently ignored by the TTM to the detriment of any TTM-based intervention. Additionally, when considering the complexity of dietary behaviours as discussed earlier, Ni Mhurchu et al. [186] suggest that an individual may potentially be categorised into multiple stages; something that has not been accounted for in current TTM-based programmes.

Other individual models of change include the Health Belief Model [210] (HBM) and the Theory of Planned Behaviour [4] (TPB). The HBM focuses on the individual influences and characteristics that affect an individual's perception of the seriousness of a condition and the likelihood that it will happen to them as an indicator of whether or not they will engage in health behaviours and actions to avoid the condition. Browning and Thomas [50] say of the HBM:

> *The model provides a common sense way of understanding why people do or do not engage in healthy actions but ignores the influence of social factors and emotional responses on behaviour.*

Similarly, the TPB proposes that intentions precede actions, and that intentions are influenced by the intrinsic value of the action, the social appropriateness of the action, and perceived behavioural control. Interventions based on the TPB have been criticised "for not incorporating broader social and structural influences on behaviour and focusing on perceived rather than actual control" [50].

Self-efficacy is central to all of the models described so far; it refers to the degree of confidence that an individual has with respect to being able to achieve a particular task/behaviour. While it has been suggested earlier that intention to change does not necessarily precede change, self-efficacy has been found to predict behavioural change [18, 19]. As suggested in the previous paragraph:

> *Health behaviour change interventions that incorporate self-efficacy focus on convincing the person that they have the personal resources required to act in the required manner. [50]*

Given the proven correlation between self-efficacy and change it would seem sensible to include strategies within the design of systems to promote health-related behavioural change. However, consideration should also be paid as to how technologists can avoid the relatively narrow focus of individual models of change and contribute to the development of actual, as well as perceived, control. Interpersonal models of health, although less frequently used, offer insight into how external resources can be harnessed and external constraints addressed.

2.3.2 Interpersonal

Social Cognitive Theory [18] (SCT) recognises the reciprocal relationship between behaviour, socio-environmental factors and personal factors. Socio-environmental factors, mediated by personal cognition, play a significant role in the onset of behaviour. Behaviour then, in turn, influences personal and socio-environmental factors. Despite that, the onus remains largely on the individual to change his or her behaviour irrespective of external constraints; illustrated by the five key attributes of behavioural change as identified within SCT and presented in Table 2-2 overleaf.

On an interpersonal level, social support has been widely acknowledged as having a positive correlation with health [13, 30, 57, 176] and health-related behavioural change [66, 123]. Despite such broad acknowledgement, the underlying dynamics and

mechanisms of social support remain unclear [66, 246]. Chronister et al [66] describe social support as "a broad multidimensional construct with no single definition", and goes on to highlight three commonly considered dimensions of social support: structural, functional and perceptual.

Attribute	Description
Symbolisation	Symbols are viewed as mechanisms for thought, and help individuals to remember the consequences of previous actions in order to speculate the results of future behavioural change.
Vicarious Learning	The ability to learn through observation. Observational learning processes include determining the relevance of other's behaviour in relation to .
Forethought	Generating an expected outcome from an as yet unperformed behavioural change.
Self-Regulation	Determines any behavioural change that occurs and any subsequent self-imposed consequences. It relies on internal and external factors such as self-motivation and social and moral standards.
Self-Reflection	When an individual analyses his or her own thought processes, actions, and experienced outcomes, and learns from them.

Table 2-2: Social Cognitive Theory's Five Key Attributes of Behavioural Change

The structural dimension of social support reflects the quantity of contacts in an individual's social network and the characteristics of the network with respect to composition and patterns of interaction. The most easily measured dimension of social support, it is also has the least convincing correlation with health [66, 195, 214]. Quantity does not necessarily equate to quality. Particularly when considering health-related behaviours, having a large circle of friends who smoke would be unlikely to assist someone following a smoking cessation plan. However when considering extremes, those who are socially isolated are undoubtedly disadvantaged over those with support networks, social isolation having been identified as a risk factor for cardiac conditions and recovery [52, 176, 233].

It is broadly agreed that the functional dimension of social support can be divided into four subtypes: emotional, instrumental, informational and appraisal [30, 57, 66]. Examples of each subtype are listening and encouraging (emotional), giving practical assistance (instrumental), giving advice (informational), and giving feedback (appraisal). Although the correlation with health undoubtedly depends on the quality of the support e.g., being given the right advice, functional support is considered to be the most effective indicator of health outcomes [66, 195, 214].

Highlighting the subjective nature of social support, the perceptual dimension refers to an individual's appraisal of his or her support network. Such an appraisal may be of the support network as a whole, e.g., does the individual feel that he or she 'belongs', or it may be more specific, relating to whether or not the recipient of the supportive gesture considers it to be support or not. Using an example from one of the studies carried out as part of this thesis: a woman who is trying to lose weight opens a packet of crisps and her husband then suggests that she shouldn't have them as she is on a diet. Although he may have intended this to be encouraging, she did not see it as such and therefore no support was received. This example is discussed further in Chapter 6. Perceptual support is strongly correlated with psychological well being [66].

Theory of Social Influence	Description
Social Facilitation	Individuals feel a pressure to perform when in the company of others
Social Comparison	The formation of attitudes and behaviours through comparison of self with others
Normative Influence	Changing to conform to the expectations and behaviours of others
Social Learning	Learning through the observations of others actions and consequences of actions

Table 2-3: Overview of Theories of Social Influence

Social influence is also very relevant to interpersonal considerations of health-related behavioural change. Four major theories are social facilitation [259], social comparison [96], normative influence [242], and social learning [17]. Although less frequently featured in the medical literature than social support, they underpin many of the individual and interpersonal theories of behaviour and behavioural change discussed so far and are commonly featured in the designs of emerging persuasive technologies that are discussed further in Section 3.3.

2.3.3 And Beyond

Looking beyond the individual and generally individually oriented interpersonal models of behavioural change there are approaches that address health and health-related behavioural change from a more community-based or population-wide perspective. Social marketing campaigns approach the individual as a consumer, using mass media often in conjunction with localised community-based interventions. The aim of social marketing campaigns is to 'sell' health messages to particular populations of concern:

> *Research is conducted to identify target audiences' demographic, behavioural, psychological and media profile. Communications and strategies are tailored to reach consumers based on this research. Typically, products or messages are pre-tested with the target audience, and further research is conducted to evaluate the impact of the intervention once it is disseminated. [85]*

In the UK social marketing campaigns are often employed by the Department of Health, sometimes in conjunction with industrial partners. Recent examples include the *5 a day*[6] and *Change4Life*[7] campaigns.

In stark contrast to this approach, community organisation models [43, 54, 248] emphasise the need for issues and problems as perceived by the community, rather than external agencies, to be addressed [173, 247]. Key concepts of the community organisation models are presented in Table 2-4 below (as identified by Breinbauer and Maddaleno [44]).

Concept	Description
Empowerment	Gaining mastery of own lives in the context of changing own social and political environment to improve equity and quality of life.
Critical Consciousness	Developing an understanding of the root causes of problems.
Community Capacity	The confidence and skills to solve problems effectively.
Participation and Relevance	Becoming actively involved and possess a collective sense of readiness to change based on own felt needs, shared power, and awareness of resources.
Issue Selection	Identification of the problems the community feels most strongly about.

Table 2-4: Breinbauer and Maddeleno's Key Concepts of Community Organisation Models

Similarly, Davis et al. [76] suggest that focusing on behavioural change alone may be inefficient when "so many forces in the social, cultural, and physical environment conspire against such change". They suggest that rather than focusing on risk factor aversion, effort should be made to develop community-based resilience-focused interventions, where resilience is described as "the ability to thrive despite the presence of risk factors". Particularly concerned with developing public health interventions within vulnerable communities of low socioeconomic status, Davis et al. [76] created a community assessment toolkit "to help communities bolster factors that will improve health outcomes". The toolkit is composed of four clusters of community resilience factors: built environment factors, services and institutions, structural factors, and social capital factors.

[6] http://www.5aday.nhs.uk/
[7] http://www.nhs.uk/Change4Life/

Social cohesion and social capital are closely linked and the differences between them are often overlooked. Robert Putman's definition of social capital [201] is the most commonly used within public health:

> *Connectedness amongst individuals- social networks and the norms of reciprocity and trustworthiness that arises from them.*

It has been suggested that this definition is in fact inadequate and only refers to social cohesion [57], and that social capital is actually the product of social cohesion:

> *The aggregate of the actual or potential resources, which are linked to possession of a durable network of more or less, institutionalised relationships of mutual acquaintance and recognition. [42]*

In his attempt to generate a Bourdieu-inspired conceptual framework of neighbourhood social capital as health determinant, Carpiano [57] defines four forms of social capital. These forms are listed below with Carpiano's given theories of how these factors may affect health:

- Social Support: a source that "individuals can draw upon to cope with daily problems".

- Social Leverage: a source of "information that can be used to maintain or improve individuals' quality of life".

- Informal Social Control: "is used to combat social disorder. Therefore this form can have positive health benefits by generating actual and perceived neighbourhood safety".

- Community Organisation Participation: participating in formally organised community activity, that "at the most basic level, provide[s] individuals with activities, which are good for health and well-being".

It is easy to see how social support and social leverage could have an effect on health. If an individual already has health problems but cannot ask anybody to help them with daily chores then their health may deteriorate (social support). Likewise, an individual with no positive role models may not be encouraged or inspired to make lifestyle changes that somebody with positive and helpful peers may (social leverage). The remaining examples

given for the final two factors are somewhat less obvious. Combating social disorder may generate perceived neighbourhood safety, but may also cause stress and provoke retaliation (informal social control). Similarly, providing individuals with activities may be good for health and but is also a potential source of stress (community organisation participation). It is important to note that the four points listed above are indeed theories, as "no studies to date have attempted to assess [the factors'] relative effect on health and well-being" [57], and in relation to physical activity, there are few studies that empirically link social networks with activity levels [123]. Nevertheless, the framework provides an actionable basis for future research into social capital-based health interventions.

2.3.4 Summary

This section has presented an overview of the dominant models of health-related behavioural change that address individual, interpersonal, and community or population-based change. Traditionally the onus has been placed on the individual to implement behavioural change, as encapsulated by the Transtheoretical Model, the Health Belief Model, and the Theory of Planned Behaviour. Interventions guided by such models focus on increasing the individual's belief that change is possible rather than addressing external barriers which may actually prevent or reduce the likelihood of change. However, regardless of this limitation self-efficacy has been positively correlated with change.

Interpersonal theories acknowledge the external influences on behaviour, and while the Social Cognitive Theory has been criticised for retaining a relatively individual-centric focus, it does offer insight to the social processes involved in change through the identification of social norms and vicarious learning as attributes of behavioural change. Social Support theories also offer insight into the influence that peers have on health-related behavioural change and health outcomes. Various forms of social support were presented, with functional support being suggested as the most effective. Four theories of social influence were also presented that feature in the design of many socially oriented systems that promote health-related behavioural change.

The section concluded with a brief overview of social marketing and community-based theories of health-related behavioural change. Like the previous models of change, social marketing places the responsibility for change on the individual, albeit on a larger scale. In contrast, community-based models explicitly address the external constraints so far neglected and furthermore, place an onus on the importance of change being driven from

within a community rather than being imposed from outside. Community-based models therefore, reflect the health promotion paradigm introduced at the beginning of Section 2.3, rather than behavioural change per se. We will return to the notion of health promotion as an alternative to behavioural change in the latter part of this thesis (see Chapter 9); social capital, in particular, becomes intrinsic to our argument over the coming chapters. For the moment we will continue by considering behavioural change techniques and current technological embodiments.

2.4 Behavioural Change Techniques and the State of the Art

In Hardeman et al's [119] review of behavioural interventions to prevent weight gain, addressing either or both dietary intake and physical activity, the most commonly used behaviour change methods were:

- information provision
- use of incentives or rewards
- goal setting
- self-monitoring
- homework
- social support
- environmental changes

In most cases the studies did show a positive influence on both behaviours, but the study design or description of interventions prevented the long-term effectiveness of the interventions being evaluated [119]. This is an often-made criticism of clinical trials of behavioural change interventions [85, 127, 169, 178, 245, 246].

More recently Dixon and Paxton [85] reviewed dietary interventions delivered within the primary care setting[8] and found that information provision alone was ineffective, but pairing information provision with "more intensive, sustained and personalised interventions have demonstrated promising results, particularly those interventions targeted at people with increased risk". Similarly Morris and Choi [178] found that people were

[8] Health Centres, GP Surgeries, etc.

willing to attempt changes to their physical activity levels when prompted to in a primary care setting, but maintaining long-term changes appears to be more of a challenge; with the most significant improvements in activity being found in the previously sedentary. The findings of Dixon and Paton [85] and Morris and Choi [178] support previous work that suggests that the inclusion of a variety of behavioural change techniques is associated with greater success [169].

In primary care interventions social support is primarily offered formally through health care professionals. However, as Verheijden et al [246] point out:

> *Most of the dynamics of behaviour change take place in patients' private and work settings. In these situations, social support from people's natural environment plays an important role.*

However, in line with the previous findings of Hogan et al's [127] investigation into the effectiveness of social support interventions within a range of health domains, while most peer-based weight management interventions showed beneficial outcomes, study design prevented concise evaluation of the effectiveness of social support [246]. Details of the forms of peer-based weight management interventions can be found in Chapter 6. Domain-specific literature surrounding social support will be presented at the beginning of each of the corresponding study chapters.

2.4.1 Technology

Technological contributions to current behavioural change programmes have so far taken one of two forms: self-monitoring devices or online resources. We shall now consider each of these in turn before moving on to the emerging technologies being developed within the HCI and Ubicomp communities in the Chapter 3.

2.4.1.1 Self-Monitoring Devices

Probably the most widespread and least invasive self-monitoring device is the pedometer. Pedometers are small devices (~45mm x 22mm) that are generally clipped to a user's waistband or shoe, and infer a user's step count from the motion of the device. An often-cited limitation of the most commonly available inexpensive pedometers is their volatile accuracy. Factors that affect the accuracy of a pedometer's step count include the position at which the pedometer is being worn, whether or not the pedometer is tilted, the length of an individual's stride, and the quality of the pedometer itself. A recent investigation into

the accuracy of commercial pedometers reported that of the 973 tested only 25.9% accurately detected the step count of wearers with an error margin < 10% (when compared to the valid total detected by the clinically proven Yamax Digiwalker) [79]. Over a third of the pedometers deviated by more than 50%. Most of the pedometers overestimated the actual steps taken, and the report concludes that, "inexpensive 'Stepping Meters' can not be used in community interventions since they will give participants the wrong message". Regardless of accuracy, the pedometer's inability to differentiate between the speed and incline of steps taken also places limitations on the usefulness of the data that it provides.

Despite their limitations, pedometers are widely used within public health programmes and PA-interventions, and have been found effective in increasing an individual's daily step count when used within the context of a behavioural change programme [59, 228, 241]. However, it has been found that the increase in step count plateaus after four weeks [59, 241], and other studies suggest that it is the programme, rather than the pedometers, that promote behavioural change [36, 93, 212]. Alternative approaches to sensing physical activity that overcome some the aforementioned limitations of pedometers are presented in the following chapter.

Wearable heart rate monitors (HRM) and physiological sensors such as SenseWear[9] offer a more physiological perspective and are slightly more intrusive in that they involve wearing a strap around the chest (HRM) or arm (Sensewear). A common tool for the sports or fitness enthusiast, we are unaware of any PA-intervention that advocates use of such physiological monitoring tools (apart from in programmes that deal with high risk populations such as cardiac patients). There are many studies in the medical literature relating to the validity of Sensewear and its use in monitoring the energy expenditure of particular populations. Only one was found that evaluates its use as a behavioural change tool; where it was found to increase weight loss on a 12-week in-person counselling-based weight loss programme [194]. This provides an interesting example of when an arguably superior technology is not deemed appropriate for a particular task. There are several possible reasons as to why they have not been adopted. In the case of the HRM although the data provides more insight into the physical exertion and fitness of an individual, the fact that it is not providing information about the physical activity itself means it does not lend itself well to behaviour-related goal setting and progress monitoring which are often intrinsic components of a behavioural change programmes. Sensewear, however, does

[9] http://www.sensewear.com

provide behavioural data in addition to physiological data. It could be that a combination of complexity and cost makes it an unsuitable competitor to the pedometer.

2.4.1.2 Online Resources

Online resources either take the form of information portals, web-based interventions or online support communities. Reflecting the lack of certainty regarding the effectiveness of offline approaches to behavioural change (see beginning of Section 2.4), a recent review of internet-based physical activity interventions also concluded with a call for better study design and standardised outcome measures [245]. The studies supported the efficiency of an internet-based intervention against a waiting list or attention-control group, although the effectiveness of the individual components of the internet-based interventions remains to be established. Of particular interest, given technology's capabilities for adaptability and tailored interactions, is that no significant difference was found in the studies that compared personalised with generic information, nor between web vs. paper-based tailored information; findings also supported by Marcus et al [166].

Findings are equally ambivalent with respect to the effectiveness of internet-based dietary interventions. In a review carried out by Brug et al [51] no significant effects of web-based nutrition education were found and tailored interventions experience mixed results; positive effects tended to relate to awareness and/or intent to change rather than dietary intake per se. However, in the evaluation of a 12-week internet-based programme focusing on physical activity and dietary intake (reducing fat intake and increasing fruit and veg consumption), the programme was found to improve dietary intake seven months into the evaluation, while the group that had access to the internet programme and received additional community-based support had maintained an improved dietary intake and physical activity levels at follow-up (16 months) [253]. The authors conclude that environmental supports may improve internet-based interventions.

Most directly related to the peer-based focus of this work are online communities. White and Dorman [251] highlighted a number of benefits and disadvantages to receiving support online. The main benefits of online communities being that they have the potential to overcome barriers to traditional group participation such as time, distance, embarrassment, and sociodemographic factors; with potential disadvantages being a lack of group process, information overload, misinterpretation of messages, erroneous or harmful information exchange, and exclusion of those on the wrong side of the digital divide. Since White and

Dorman's critique there has been a great deal of research carried out addressing the issues that they highlighted. Maloney-Krichmar and Preece [161] carried out a 2 ½ year study of an online forum for individuals with a particular type of knee injury and, with respect to the disadvantage of lack of group processes, found that 17 out of the 25 roles associated with offline groups were present in the online group. Those focusing on the effectiveness of online support provision indicate a poor correlation between participation in online support groups and outcome measure [20, 94], but as Barak et al. [20] point out, "a support group is not expected to produce such outcomes but, rather, to contribute to the participant's general well-being".

The majority of studies into online communities have been concerned with injuries or specific diseases rather than health-related behaviours such as dietary intake and physical activity. In view of that, we will discuss the online community literature where applicable within the domain-specific chapters that follow.

2.4.2 Summary

This section has introduced the individual techniques employed in clinical behavioural change interventions and highlighted areas of promise and shortcomings. Clinical evaluations of physical activity and dietary interventions are hindered by poor design methodologies and so findings with respect to the effectiveness of particular techniques are relatively inconclusive. They do however suggest that information provision alone is ineffective, and that the use of multiple techniques is desirable. The situated nature of existing peers suggests that they are better suited to support provision than health care professionals. Investigations into the effectiveness of peer-based support within behavioural change interventions are promising but, as with the evaluation of the other behavioural change techniques, are inconclusive.

When considering the current technologies used in behavioural change interventions, pedometers are the most widely used. Despite issues of volatile accuracy they have been found to increase physical activity levels over the short term, and are favoured over more technically complex alternatives. The effectiveness of online resources such as behavioural change interventions and support communities are yet to be established. The findings that tailored information was no more effective than generic information, and that nor was web-based when compared to paper-based information seems to conflict with the general consensus relating to the benefits of using technology as an educational tool. As with the

difficulties in establishing the effect of traditional and technological behavioural change interventions, these findings may be symptomatic of the complexities of the problem space, of the limitations of taking an individual-level approach, or a combination of the two.

2.5 Discussion

This chapter has argued that the problems of physical inactivity and poor dietary intake are widespread and complex. It has presented the global burden of chronic diseases, half of which are strongly linked to the two behaviours of concern to this thesis. Post-industrialised society has been blamed for many of the chronic diseases and associated behaviours that we face today. In the course of their everyday lives people have to walk less, and have less physically demanding jobs. The availability and convenience of convenience food overrides nutritional and caloric value. We find ourselves in what Ogilvie and Hamlet refer to as an "obesogenic society" [189]. In addition to the organisational and environmental impacts on health-related behaviours, sociodemographic factors such as age, gender and socioeconomic status all contribute to the likelihood of an individual's participation in unhealthy behaviours and experience of ill health.

Existing models of health-related behaviour and behavioural change reflect the various levels of health determinants ranging from individual to organisational. The dominance of the individual models and individually focused behavioural change techniques can be explained in part by the longstanding authority of medical rather than social models of health. From a pragmatic perspective it is arguably easier to address the beliefs and practices of an individual than a group of individuals such as a family or community. However, despite years of research there is relatively little evidence to support the longevity of any behavioural change produced by such interventions. Similarly, despite widespread acknowledgement of the positive correlation between social support and health, when considering the effect of social support interventions, a lack or understanding regarding the underlying mechanics of social support and methodological issues prevent conclusions regarding the effectiveness of such interventions from being drawn.

Understandably following the dominant trend, initial technological interventions in this domain have mirrored traditional behavioural change techniques and the format of behavioural change programmes. The automated monitoring of physical activity has proved effective in the short-term. Ambivalent findings with respect to the provision of

online behavioural interventions initially seem discouraging. However when considered alongside the effectiveness of offline equivalents, are less so and perhaps more understandable. As speculated in Section 2.4.2 these findings may be symptomatic of the complexities of the problem space, of the limitations of taking an individual-level approach, or more likely, a combination of the two.

Behavioural change therefore, as a discipline, is very much a work in progress. The relatively little impact that intensive in-person behavioural change programmes have had may lead some to draw the conclusion that technologists are not in a position to contribute to the problem space. However, the outstanding need prompts us to suggest that technologists are in a position to contribute. If traditional methods were working (on the large scale over the long term) then this thesis would not be needed.

What is needed, and what we strive to do within this thesis, is to reflect on technology's role in promoting positive health-related behaviours. Should future efforts continue to focus on emulating offline behavioural change techniques? What are the alternatives? Should we focus on alternative paradigms such as those encapsulated by community based models of health which reject the implicit goal of modifying the behaviours of individuals such that they adhere or become closer to medical guidelines, instead focusing on addressing inequalities in health and opportunities as perceived as problematic by the communities themselves?

If being developed for use within a behavioural change programme it is likely that any technological intervention should reflect the programme's orientation. However, if being designed for everyday use then we suggest there is scope for alternative approaches.

2.6 Conclusion

This chapter has provided an overview of health-related behaviours and the problem of behavioural change from a sociomedical perspective. First presenting the burden of chronic diseases and highlighting their strong association with physical inactivity and poor dietary intake, the chapter then presented the main models of health-related behaviour and behavioural change before discussing the strengths and limitations of each. Behavioural change techniques were introduced so that the reader is familiar with the theoretical grounding of behavioural change interventions emerging from HCI and related fields. However, given the strengths and limitations of current techniques we argued for a rethink

of technology's role in behavioural change, particularly when considering non-clinical technological innovations. The next chapter presents an overview and critique of the systems emerging from HCI and related domains, most of which are non-clinical, that form a new genre of health application: everyday behavioural change technology.

3 Everyday Behavioural Change Technology

The previous chapter provided an overview of the sociomedical grounding of health-related behaviour and behavioural change. By synthesising the current approaches from multiple domains, emerging technological interventions can be placed within the interdisciplinary landscape. In this chapter we will present a review of technologies emerging from the HCI and Ubicomp communities that have been developed for the purpose of promoting health-related behavioural change, or have been offered as potential contributions to the problem space.

3.1 Introduction

The concept of everyday behavioural change technology was introduced in Chapter 1 as a genre of non-clinical applications that have been designed to promote health-related behavioural change. By referring to this genre of technology as non-clinical we are highlighting the fact that these applications have not been designed for use within a formal behavioural change programme, or as part of a clinical programme of condition management. That is not to say that such technology could never be used within a formal behavioural change programme. The point of highlighting the difference between clinical and non-clinical applications is because by being non-clinical, everyday behavioural change technology needs to be technology that individuals willingly engage with and use because they want to, not because they are told to.

Although this thesis is primarily concerned with the application rather than the underlying infrastructure of technology, the prevalence of self-monitoring within the emerging systems prompts us to start Section 3.2 with an overview of current approaches to the automated monitoring of physical activity and dietary intake. Section 3.3 presents a critical review of HCI's current efforts to promote health-related behavioural change, with particular attention paid to those that includes a social aspect. In cases where alternative approaches have been implemented in clinical or condition-specific systems, they too will be included in the discussion. Domain-specific critiques will follow in subsequent chapters. The main concern of this chapter will be to highlight the underlying assumptions made about the nature of behavioural change and peer-involvement in the same, which will be discussed in Section 3.4.

3.2 Sensing Behaviours with Ubiquitous Computing

The original motivation for interest in the task of monitoring activities and inferring human behaviour originates in Weiser's vision of invisible computing [250]:

> *The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.*

Technology was envisioned that could respond to the context of a user in such a way that using the technology becomes effortless. In order to respond, technology would first have to be able to detect the context of the user. Through networks of sensors distributed around an environment or worn on a body such ability has, in part, transpired. For thorough discussions on the current state of ubiquitous computing and the challenges of context-aware computing please see [22, 25, 26, 207].

Over recent years efforts have been made to exploit the sensing capabilities of ubiquitous computing for the purpose of monitoring health-related behaviours. Such capabilities enable everyday behavioural change technologies to encapsulate the behavioural change technique of self-monitoring, which they invariably do. The emerging generation of sensing technologies is moving beyond step counting and physiological monitoring to physical activity inference and observation of dietary intake. Here we consider ubicomp's approach to sensing physical activity and dietary intake, before considering any surrounding applications in the following section.

3.2.1 Physical Activity

Algorithms exist that can process the data produced by multiple accelerometers worn on different parts of the body to deduce the current activity of the wearer [152]. The effectiveness of these algorithms depends on both the number and position of the accelerometers worn. One issue relating to the quantity and location of the required accelerometers is that of convenience; if a multi-accelerometer system is to be used over a period of time as opposed to on a one-off occasion then setting the system up for use will become a non-trivial daily task for its user. One approach to resolving this problem is to avoid the distribution of multiple homogeneous sensors, instead using a heterogeneous collection of sensors on a single site. The Mobile Sensing Platform (MSP) is an example of such an approach [65]; the MSP is 5.8cm*2.8cm and includes a microphone, accelerometer, compass, barometer, ambient light sensor, and humidity/temperature sensor. In an evaluation involving 12 individuals during intermittent periods over several days, it successfully distinguished between 8 physical activities with a success rate of ~90%: sitting, standing, walking, walking up stairs, walking downstairs, riding an elevator up, riding an elevator down, and brushing teeth. The MSP was trained to recognize activities from 3 bodily positions (wrist, shoulder, and waist) with similar success. Such a single-site sensor board that can be positioned in multiple on-body locations overcomes the aforementioned problem of system set-up.

Wearable Force Sensors [157] (WFS) provide an alternative approach to detecting and distinguishing between activities such as walking upstairs, downstairs, normally, and abnormally (long stride). Although leg movement during each of these activities is visually similar, the actual muscular movement of the leg is quite distinct. 1cm^2 force sensors placed on the front and back of the thigh are able to detect patterns of muscle pressure that can be placed into one of the four activity categories. In an experiment with four subjects where they were asked to perform the four activities, there was “excellent separation” between the sensed data for each activity, although there was an element of overlap between abnormal and normal walking data. In order to overcome positioning and sensor displacement issues 4*4 1cm^2 force sensors were used and were positioned using a bandage. It was suggested that the sensors could be integrated into clothing in the future, thus causing system set-up to be less inconvenient for the user.

More recently, accelerometer-based activity sensing has been incorporated into mobile phones such as the Nokia n95 and the iPhone. Integrating activity sensing into commodity

technology undoubtedly increases the convenience for the user, presuming they already carry their mobile phone with them, but reduces the granularity of the data captured. The trade off between convenience and accuracy is considered further in Section 3.4.

3.2.2 Dietary Intake

While various approaches to automated physical activity monitoring have been established, the automated monitoring of nutritional intake is more problematic. A multitude of approaches to sensing have been developed that span the process of buying, preparing and eating food. To monitor dietary intake at the point of sale barcode scanning [71] and optical character recognition [164] has been proposed. Instrumented food containers [61] and cooking areas [62], enabled by RFID technology and weighing surfaces, sense meals as they are being prepared while similarly instrumented dining areas enable the monitoring of individual meals. Finally, by detecting the sound of a person chewing, it has been suggested that auditory sensing is a possible approach to detecting the dietary intake of an individual [7]. In all of the approaches discussed so far, converting the sensed input into nutritional value depends on the existence of a comprehensive database of food items and corresponding cooking practices. Databases do exist, but are currently limited in scope to major brands and do not account for the impact of portion size and cooking practices.

As can be seen by the various points of focus, the degree of granularity of data varies from what food is brought into the house to what food is consumed by the individual. One limitation of RFID-based approaches is illustrated by the Diet-Aware Dining Table [61], which is an example of how embedded pervasive sensors can be used to augment existing household objects to observe dietary intake. An RFID surface and weighing surface are situated underneath a dining table. Through changes in weight and position of RFID-tagged food containers the system can successfully monitor (with 80% accuracy) how much food each person sat at the table has eaten. 80% accuracy means that the Diet-Aware Dining Table is “at least as accurate as the accuracy of traditional dietary assessment methods”. A weakness of this system and subsequent claims is the assumption made that the food containers are already accurately labelled with the RFID tags. An additional limitation arises from the presumption that is made about the eating practices of potential users; that people eating at the table will serve themselves at the table, as opposed to the food being served up on plates.

3.2.3 Summary

This section has presented self-monitoring technologies that are emerging for the Ubicomp community. Physical activity monitoring tends to take the form of on-body sensing, ranging in invasiveness from mobile phones to wearable sensors. Monitoring dietary intake, on the other hand, tends to involve instrumenting cooking or eating areas. While physical activity can now be monitored fairly accurately to a relatively fine granularity, there are outstanding challenges for the automated monitoring of dietary intake that are then further complicated by the problem of providing nutritional information. Despite the current discrepancy between the current monitoring capabilities for physical activity and dietary intake, there is a similar trade off between convenience and accuracy for both physical activity and dietary intake monitoring. This trade off will be discussed further in Section 3.4. As was mentioned in the introduction, self-monitoring (automated and manual) features heavily in the design of behavioural change interventions emerging from HCI and related communities. The next section presents a critical review of those systems.

3.3 Persuading Behavioural Change in HCI

In his overview of Captology—the study of computers as persuasive technologies—Fogg [98] defines persuasion as "an attempt to change attitudes or behaviors or both", and more specifically focuses on "attitude or behavior change resulting for human computer interaction (HCI), not from computer-mediated communication (CMC)". Although some of the systems emerging from HCI do include an aspect of computer-mediated communication (as can be seen in Section 3.3.4), most take the form of persuasive technologies as described above. We do not claim to address every aspect of the underlying theory of persuasive computing in this chapter, for that we refer the reader to [98]. Instead we focus on current instantiations of persuasive technologies. As was suggested in Chapter 2, the clinical influence on HCI's approach is evident in the encapsulation of traditional behavioural change techniques in emergent designs. This section is therefore structured around the four behavioural change techniques that are represented in this genre: self-monitoring, goal setting, information provision, and social influence.

3.3.1 Self-Monitoring

As mentioned earlier, self-monitoring is the most frequently featured behavioural change technique in health-related persuasive technologies. However, in emerging designs it does

not feature alone, self-monitoring is used in conjunction with other behavioural change techniques, and so will be discussed in the subsequent sections.

3.3.2 Goal Setting

Accompanying self-monitoring in the majority of physical activity systems is the ability to set goals and record goal-related progress. The most simplistic approach to determining physical activity or dietary intake goals can be found in Chick-Clique [238] where users set their own daily step count goals, and the Lifestyle Coaching Application (LCA) [103] where users are asked to achieve seven lifestyle points per day (1 lifestyle point= 1 portion of fruit/veg or 10 minutes of physical activity). While the locus of control remains with the user in Chick-Clique, an important factor when considering self-efficacy in behavioural change [5], thus enabling the user to determine the degree of change that he or she wants to make, this approach also runs the risk of relying on the user to set an appropriately challenging goal. Goals that are either too difficult or too easy can fail to inspire change [231]. Although LCA does not ask the user to identify daily goals, by using generic goals for all users, it also runs the same risk of imposing inappropriate goals that are too difficult or too easy.

In Houston [72] and Fish'n'Steps [153], the problem of avoiding inappropriate goals was addressed by basing personal step-count goals on the baseline step-counts of each user. The methods employed in each differed. Consolvo et al [72] modified the approach proposed by the Walking Works programme [198] to determine a static goal for the two-weeks of the user-trial of Houston. In Fish'n'Steps, Lin et al [153] used the findings of previous pedometer studies to identify a realistic step-count increase, and then tailored it to the individual using an exponential function to set goals for each of the six weeks of the user-trial. Each daily goal was an incremental increase towards the week's goal. Of all of the approaches, Lin et al's appears to be the most sophisticated. Unfortunately there are no directly comparable results to establish the strengths and weaknesses of each.

Apart from Chick-Clique where feedback was presented to users in the form of text messages, each of the goal-setting systems so far provided visual feedback to the users when daily goals were achieved. Again they varied in complexity, ranging from an asterisk annotation in Houston to the development of an animated character in Fish'n'Steps. The motivation behind the development of a character goes beyond the straightforward mechanism of feedback, aiming to cultivate "a strong internal locus of control through care

of pet or plants" [153]. This approach was repeated in Consolvo et al's subsequent application, the Ubifit Garden [73, 74], whereby the individual's level of physical activity was reflected in the 'wellness' of a garden environment visualised on the individual's mobile phone screen (see Figure 3-1). Other researchers have started to investigate the potential for ambient persuasion, whereby visual feedback about physical activity levels are presented peripherally e.g., through an augmented mirror [102].

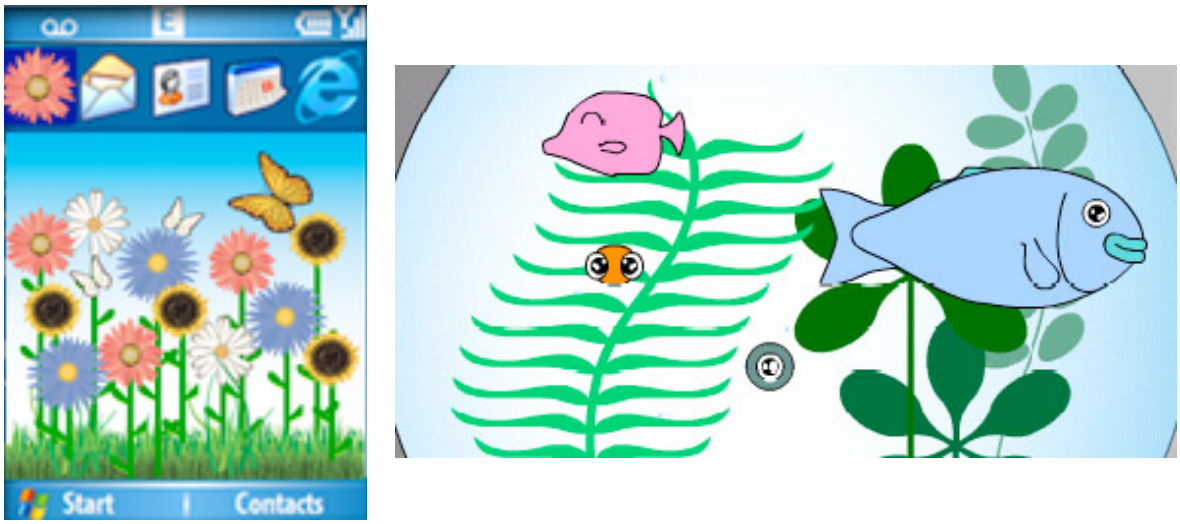


Figure 3-1: Physical Activity-Affected Interfaces in Ubifit Garden (left) and Fish'n'Steps (right)

Alternatively, Hyperfit [136] embodies a more heavyweight approach to promoting health-related behavioural change, "the principle of the service is to mimic the process of personal nutrition counselling". Using a combination of validated questionnaires and national guidelines, goals are developed and presented to the user through a virtual coach. Feedback is also generated through the coach, and self-monitored data is used to develop further goals. Again the trade-off between accuracy and convenience is evident:

> *The system provides a huge amount of information for those who are ready to put on the effort of keeping their diet and exercise records with care. [...] The limitation of this kind of service is that many people are not willing to make the required effort.*

As implied by the quote above, Hyperfit marries goal setting with in-depth information provision, another behavioural change technique. Goal setting is rarely used as a standalone motivational tool, if at all. More commonly, goal-setting has been framed within the context of a game [103, 153] or a social awareness application [72, 238], explicitly introducing aspects of teamwork, competition, and social facilitation into the

process of behavioural change. The following sections discuss the final two behavioural change techniques being utilised by the HCI community: information provision and social support.

3.3.3 Information Provision and Recommendations

As much as goal-setting primarily features within the physical activity domain, providing information about currently monitored behaviours and making recommendations about alternative behaviours appears to belong to the dietary domain. The aforementioned difficulties associated with monitoring dietary intake are compounded by the additional requirement of establishing the nutritional content of dietary intake. The most commonly proposed solution is to link the data collection to a nutritional database lookup and associated calculation. A limitation of this approach is the challenge of establishing and then maintaining an adequate nutritional database. Allowing users to make manual entries into the database is one proposed solution to the problem [240]. An alternative approach is employed by Hyperfit [136], which calculates the average nutritional value for that particular type of food.

Chi et al [63] hypothesised that raising an individual's awareness about the caloric content of a meal as it is being prepared will "thus enhance family cook's willingness to make healthy meals with the appropriate amount of calories". The results of a short-term user study of their instrumented kitchen with three individuals who had expressed a desire to learn how to cook more healthily appeared to support their hypothesis. Using a similar calorie-based representation of dietary intake in their clinical application for overweight and obese individuals, Tsai et al [240] developed PmEB, a mobile phone application that allows users to enter dietary intake and physical activity which is then used to calculate the individual's current caloric balance. The system fared modestly during a comparative usability and feasibility evaluation against a paper equivalent, scoring "the same as or better than [...] the paper diary in nearly all categories".

Systems have also been proposed to go beyond simply raising awareness of dietary intake to help those already persuaded or motivated to make a change to their nutritional behaviours. Mankoff et al's [164] OCR-based system scanned shopping receipts and offered nutritional information alongside suggestions of healthier purchases. Alternatively, the ease of data capture afforded by the photographic method can be traded off against

automated nutritional analysis; in the commercial application myFoodPhone[10], a nutritionist provides nutritional feedback to the system instead of a database. This labour-intensive task can be avoided by using the photograph itself as a reflective prompt. Smith et al [223] combine physiological data (blood glucose levels) and photographs representing behavioural (diet and exercise) data within a diabetes journal; the motivation behind the system being to provide a resource for reflection and analysis for both the diabetic and the healthcare professional. Although no formal evaluation of the effect of the journal on behavioural change has yet been carried out, through interviews carried out as part of a 4-week qualitative study of the journal researchers found that participants engaged in:

> *Thoughtful discussions about the pressures of living with the disease, consider the consequences of their actions as they photograph them, and use the capture and visualization tools to understand how and why their blood glucose levels are in or out of control. [223]*

Despite earlier investigations indicating that single-user systems would foster confirmation bias due to the lack of "social critique" that had previously been afforded within the confines of an educational programme [101], no episodes of confirmation bias were observed in the later study [223].

3.3.4 Social Support and Social Influence

While Frost et al's [101] initial studies touched on the role that others play in the development of understanding through reflection and debate, Mamykina et al [163] developed MAHI to explicitly support such interaction between newly-diagnosed diabetics and diabetes educators. Somewhat similarly to Frost et al., they sought to augment physiological data with photos, voice memos, or written queries, which could then be used by the individual as a reflective tool or to prompt a response from the diabetes educator:

> *It does not place the clinical professional in charge of generating opinions and choices. Instead, MAHI allocates them an advisory role in facilitating individual's sensemaking, but not replacing it. [163]*

More commonly within the HCI literature, attention is being paid to harnessing the potential behavioural influence of peer-based support. Each of the lightweight goal-based systems introduced earlier (Houston, Fish'n'Steps, Chick-Clique, and LCA), included a degree of social influence. Both Fish'n'Steps and LCA encapsulated behavioural goals

[10] http://www.myfoodphone.com

within the context of a team-based game, thus explicitly introducing competition and social pressure. In contrast, Houston and Chick-Clique both integrate social influence through social facilitation and social support. In those systems, peers do not explicitly compete with one another but can view and comment on the progress of their peers.

In addition to such peer-based interventions, others have started to look at the potential for community-based systems. Grimes et al [116, 117] have been looking at the community influences on health-related behaviours within low-income African American communities and have called for the collectivist nature of these communities to be accounted for in system design. This argument supports other work done in the area of smoking cessation interventions for New Zealand Maori populations [141, 142]. These culturally sensitive works will be discussed further in Chapter 7.

3.3.5 Behavioural Outcomes

This section has presented the current approaches to promoting health-related behavioural change that are emerging from the HCI community. Before considering a meta-analysis of the underlying assumptions about health-related behavioural change, we should first discuss the limitation that affects much of this work; that being lack of adequate evaluation.

Unfortunately very few of the dietary systems that have been discussed so far have been evaluated to establish their effect on behavioural change. A limitation of the heavyweight monitoring solutions is that they cannot yet be, or at least have not been, deployed into real households. While Chang et al's [61] lab-based experiments remain focussed on sensing accuracy rates (~80%), Chi et al [63] have shown that when cooking in the lab-based instrumented kitchen, all three users reduced the caloric values of the meals that they cooked, albeit in a very constrained scenario, and usually be reducing ingredient portion sizes.

During an evaluation within a 4-week diabetes education programme, MAHI experienced mixed success [163]. When compared to a control group who attended the same programme but did not use MAHI, use of MAHI led to a significant number of participants increasing their locus of control, but no significant changes to understanding were achieved. And while the use of MAHI led to a higher degree of success at achieving dietary goals, it did not have the same effect on non-dietary goals (regulating meal habits,

exercise, self-monitoring). One possible reason for the mixed success could be that it was deployed within an already supportive environment, meaning that further support was of limited use. This issue will be revisited in Chapter 6.

Given the relatively young age of this field of research and the outstanding limitations with sensing capabilities, it is maybe not surprising that behavioural outcomes have not yet been evaluated. In the majority of user-studies of the dietary systems researchers have instead chosen to focus on usability and feasibility issues [136, 223, 240]. In contrast, behavioural outcomes have been investigated in all of the physical activity systems mentioned so far; the majority of which have utilised pedometers to sense the behaviour of concern.

While the majority of the evaluations involved a pre-intervention period whereby baseline physical activity data was obtained, only Lin et al [153] employed a four week pre-intervention period in an attempt to disambiguate any effect of carrying the pedometer. The Ubifit Garden [73] was shown to assist individuals maintain—but not increase—physical activity over a period of 12 weeks. The relatively short pre-intervention period during the evaluation of Houston [72] and Chick-Clique [238] raises questions about the validity of claims of increased step-count. However, during the evaluation of Houston, participants were significantly more likely to achieve their behavioural goals if they were using the version that enabled social influence. These findings conflict with those of Lin et al [153] and Gasser et al [103], who found that when comparatively evaluated against single-user equivalents, team-based versions were not found to have a significant effect on behavioural outcomes. It is impossible to say whether the conflicting results are down to the mechanics of social influence or the mechanics of the experiments themselves. For example one could infer from the results that competition within physical activity systems is an ineffective form of social influence, but it is interesting to note that it was only in the evaluation of Houston did the peers already know each other. Teams were made up of strangers in LCA and were anonymous in Fish'n'Steps. Given the emphasis that the sociomedical literature places on existing peers with respect to social support [246], these findings are not surprising.

3.3.6 Summary

This section has presented the genre of behavioural change applications that we have referred to as everyday behavioural change technology but is more commonly known as persuasive computing. Structuring our review around the various behavioural change

techniques that have been integrated into the system designs, we compared and contrasted the alternative approaches that have been taken so far. Where possible we have presented the results of system evaluations, but the preliminary nature of most has prevented direct comparison.

Although self-monitoring is the most pervasive of behavioural change techniques, we were unable to find an application that relies on self-monitoring alone i.e., that presents the individual with the raw data that has been entered manually or automatically. We observed the tendency for physical activity systems to combine self-monitoring with goal-setting and social influence. Different approaches of varying complexity to goal-setting and feedback provision were discussed, as were the various mechanics of social influence. Initial user responses to the applications indicate that they are engaging experiences, but evaluations of the benefit of harnessing social influence have yielded conflicting results, and behavioural outcomes are preliminary.

Dietary systems tend to combine self-monitoring with information provision about nutritional or caloric intake and less frequently recommendations about healthy alternatives. We discussed the difficulties involved with generating such nutritional information. As a contrast to the statistical and information-heavy systems, the benefits of using photographic journals of dietary intake to promote reflection of dietary habits was also considered. Perhaps because of the outstanding challenges with respect to dietary monitoring, evaluations of dietary systems have not yet progressed beyond pilot studies and so the benefit of info-centric approaches is yet to be established.

3.4 Discussion

Section 3.2 presented self-monitoring technologies that are emerging for the Ubicomp community. While physical activity can now be monitored fairly accurately to a relatively fine granularity, there are outstanding challenges for the automated monitoring of dietary intake. Despite the current discrepancy between the current monitoring capabilities for physical activity and dietary intake, there is a similar trade off between convenience and accuracy for both physical activity and dietary intake monitoring. On-body sensing provides the finest granularity of data, but demands more from the user. Despite the apparent advances in automated physical activity monitoring all of the systems apart from the Ubifit Garden, relied on self-declaration (PmEB, LCA) or the manual entry of data as indicated by a pedometer (Houston, Chick-Clique, Fish'n'Steps, Ambient Mirror). Until

evaluated from a usability, as opposed to an accuracy perspective, we will not know where the most acceptable trade-off lies. It is likely that there will not be one gold standard that suits all contexts of use, for example, unlike the users of Shakra (Chapter 4), even completely accurate minutes of accumulated daily activity levels were of limited usefulness to cardiac rehabilitation participants (Chapter 6). An additional implication of use of pedometers and self-declaration in emerging system designs is that the potential benefits of enhanced monitoring capabilities are yet to be explored.

Similarly, the finest granularity of automated dietary intake monitoring demands the most effort from the user with respect to the accurate labelling of containers and potential adjustments to the way in which food is prepared and served. Chang et al. [61] point to the labour intensiveness of accurate manual monitoring of dietary intake currently required by medical professionals as a motivating factor behind the development of the Diet-Aware Dining Table. It can be presumed that those who stand to benefit from such accurate nutritional monitoring are individuals with a specific clinical need e.g. those in renal failure. In cases such as renal failure the adequate monitoring of particular nutrients is life critical, however for the majority this is not the case. Are we presuming that giving the kind of information that clinicians find useful and the kind of information that lay people find useful are the same? The photographic approach taken by Frost et al. [101] offers a less nutritionally accurate record of dietary intake but a visual one which may well resonate more easily with individuals who don't depend on such accurate monitoring. Although photographs do not give nutritional statistics for a computer to analyse, they do give the individual a visualisation that they can reflect on and formulate their own decision about nutritional value using their knowledge of the dietary requirements of their condition. The contextualisation of dietary intake within a broader scope of activities also presents a richer representation of activity than nutritional intake or caloric balance alone.

At the core of the systems developed so far is the ability to self-monitor the behaviour of concern. While self-monitoring is an established behavioural change technique, it could be suggested that self-monitoring has been given disproportionate attention. It is the case that technology seems to lend itself well to the task of monitoring behaviours, albeit some behaviours more easily than others. While approaches to monitoring physical activity are relatively lightweight, dietary intake systems are technically cumbersome. Perhaps the presumed ability of technology to be able to sense has driven the development of an approach to health-related behavioural change that focuses on reducing behaviour to

numeric form: minutes walked, calories consumed. Furthermore, the behaviours are always considered in isolation. They are monitored and promoted with no regard for the social, environmental, and economic context in which they are situated. For the most part, the systems appear to share the underlying assumptions that:

- People have the power and resources to make behavioural change
    - Decisions regarding physical activity and dietary intake are made in isolation with no consideration of lifestyle or external constraints
- In the case of social awareness technologies:
    - People have members of their social network who are willing to share and participate
    - Harnessing social influence and social support is a straightforward matter of broadcasting behavioural data
- Technology is or will eventually be accessible
    - Not only affordable, but that people will be motivated to use technology in this way

These assumptions will be revisited throughout this thesis. However it should be said that despite the limitations that have been put forward, the technology discussed in this section has been groundbreaking. It forms a new genre of technological health promotion, creating resources for interaction in which health behaviours can be discussed and reflected on. In the same way that the Internet eased access to information, these technologies capture and present information to the user about their health-related behaviours. If we consider Heidegger's philosophy of presence-at-hand and readiness-to-hand [125], and liken our bodies to tools, the body can be said to be generally ready to hand, and so it is somewhat unsurprising that people sometimes forget its needs. What these technologies do is momentarily bring the body to be present at hand, and promote explicit consideration of health-related behaviours.

Indeed, there are many commercial applications emerging that facilitate the kind of self-monitoring that the aforementioned research projects advocate[11]. Associated and standalone websites enable the comparison of data with other individuals and national

[11] E.g., www.myfoodphone.com, www.sensewear.com

averages[12]. And as mobile phones are being developed that contain previously exotic hardware such as accelerometers, downloadable applications for the mobile phone are available. At the time of writing[13] there were over 400 health and fitness applications in the iTunes Store, many of which involve dietary and physical activity monitoring. There is obviously a market for the technological self-monitoring of health-related behavioural data, but what kinds of people compose that market? For those who are interested in learning more about the body in general, or getting fit, eating healthily, or counting calories, this new genre of health and fitness applications makes the information more accessible, tailorable, and portable.

3.5 Conclusion

This chapter has provided an overview of the innovative technologies being developed by the HCI and Ubicomp communities. The youth of the domain as an area of academic interest is reflected in the preliminary evaluations and studies. The influence of traditional approaches to behavioural change is also evident in the designs of the systems. Despite the recognition in sociomedical literature that information provision alone is ineffective (as highlighted in Chapter 2.4), it is a heavily relied on technique in dietary systems. The social aspect of physical activity systems is yet to be validated but appears promising given the importance placed on social influence and social support (also in Chapter 2.4). Our initial explorations of this domain focussed on the problem of motivating physical activity, which led to the development of Shakra, a social awareness application of the same genre as those discussed in Section 3.3.4. The findings of the Shakra pilot-study, alongside further reflections on the systems and evaluations presented in this chapter, prompted the subsequent decision to consider the broader context of health-related behavioural change. These initial explorations are discussed further in the next chapter.

[12] E.g., http://nikeplus.nike.com/nikeplus/, http://www.fitday.com/
[13] 17th February 2009

4 Initial Explorations: Motivating Physical Activity

The previous chapters provided an insight into the sociomedical and technological background of health-related behavioural change. Chapter 2 argued that the burden of chronic disease and outstanding challenges of promoting healthy behaviours provided adequate motivation for the exploration of technology's potential contribution to the domain, and in particular the consideration of technology's role outside the confines of clinical behavioural change programmes. In Chapter 3 we reviewed current technological approaches to promoting everyday behavioural change. We highlighted the underlying assumptions regarding behavioural change and the nature of social networks, and identified the outstanding need for further research to establish the benefit of existing approaches and the exploration of potential alternatives. Here we present our initial foray into the domain of everyday behavioural change.

4.1 Introduction

It should be noted that the work presented in this chapter was carried out at around the same time that the systems discussed in Section 3.3.4 were being developed. Subsequently, many of the limitations identified in the previous chapter also apply to this work. For example, reflecting the traditional focus of responsibility for behavioural change lying with the individual, we approached the problem space by first considering individual-based

motivations and obstacles to exercise (as detailed in Section 4.2). During the motivational issue survey sociability, variability, and opportunism were found to be desirable characteristics of an exercise regime. In Section 4.3 we present Shakra, a lightweight mobile phone application that embodies aspects of sociability, variability and opportunism in the promotion of physical activity awareness. The findings of a pilot-study are framed within a discussion of current approaches to physical activity promotion as introduced in Chapter 3. Section 4.4 then reflects further on the limitations of this approach, before outlining the motivation and direction of the subsequent work that composes the main body of this thesis.

4.2 Motivational Issues Survey

A first investigation into how technology could be designed to overcome individual-level barriers to physical activity participation started with a motivational issues survey. Louise Barkhuus led the study; the author collaborated with the design of the survey and interview schedule, carried out some of the interviews and assisted with the analysis. The survey has not been published elsewhere. An overview of the study (questionnaire, interview schedule, study participants) can be found in Appendix 11.2.

In an attempt to generate a general overview of the motivations and obstacles to exercise, an online questionnaire was designed and distributed to a student sports organisation and a local white-collar company. The questions were formed around the topics of everyday activity, exercise, current use of technology, and involvement of others. At the end of the questionnaire, respondents were invited to leave contact details if they were interested in participating in face-to-face interviews about motivational issues with a member of the research team.

Obstacles to participating in exercise included lack of time, not enjoying exercise, apathy and low self-efficacy. In order to further investigate individuals' attitudes towards and experiences of motivating and demotivating aspects of physical activity, we invited questionnaire respondents to participate further in a face-to-face interview. We employed in-depth interview techniques during a semi-structured interview surrounding their current and previous physical activity practices. The interviews were transcribed and then analysed for emergent themes. Sociability, variability, and opportunism were found to be desirable, if not always possible, components of an engaging exercise regime. The findings of the study are further described below.

4.2.1 Participants

Of the 50 questionnaire respondents, 58% were female and 42% were male. The majority of respondents were within the 18-24 and 25-34 year old age ranges (44% and 38% respectively). They were asked to classify how active they were on a day-to-day basis. Most people said that they were quite active (50%), and 34% said that they were very active. Only 12% considered themselves inactive, with the remaining 2% extremely active. Most of the respondents exercised 2-3 times per week (44%), with 18% exercising 4-5 times per week, and the rest either weekly or less frequently. Despite frequent exercise participation, less than a third of the respondents felt that they did enough exercise on a weekly basis. The exercise that they took part in varied greatly from hiking to yoga to weight-lifting; the most frequently-cited was cardiovascular exercise at the gym (60%) but most did more than one type of exercise.

Ten people were recruited from the questionnaire respondents to be interviewed. We recruited 6 males and 4 females aged between 23 and 54. All but two of our participants were educated to at least degree-level and had jobs ranging from postgraduate students and outdoor activity instructors, to administrators and technologists. None of our participants were computer science students.

Perhaps indicative of the self-selectivity of this type of study, or perhaps down to activity levels in youth being a predictor of activity levels in later life, all but two of our participants reported being sporty or outdoorsy during childhood/adolescence. In the majority of cases this trend continued to the present day, although in three cases such long-term habits had ceased or changed due to age (n=2) or when finishing university (n=1). The two participants who were relatively new to purposeful exercise both cited the need to lose weight as the overriding motivation behind their recent increase in activity. Interestingly it was only these two participants, alongside the previously active university leaver, who chose to participate solely in gym-based exercise.

4.2.2 Overview

The overall attitude towards gym-based exercise was that it was monotonous, boring, and only to be used if absolutely necessary, if at all. For P8, a 54 year old woman had previously been active, participating in various team and competitive sports throughout her life, the gym provided an alternative environment for exercise now she felt that it was

inappropriate to continue competing: "... unless you join the [veteran] team you are not in the team. That sounds morose but I have got to be realistic, and I wouldn't play in a squash team any more". The other participant who had stopped participating in his lifelong sports due to age preferred to make a conscious effort to remain active throughout the day by walking to work and always using stairs instead of lifts etc. When augmenting his daily activity levels with purposeful exercise, P1 would chose to go walking rather than go to a gym:

> *If I wanted to take exercise, the motivation would be fresh air and to be outside […] I don't understand why people go running indoors when we have a beautiful countryside around us.*

This sentiment was unsurprisingly echoed by all of the participants who classed themselves as outdoorsy, whose activities included climbing, swimming, running, hill walking and cycling. All of the participants reported having used the gym at some point, but all but one (P3) rejected the thought of using a gym again. P3 relied on the gym when the weather was too bad to go running outdoors.

4.2.3 Motivation

When asked to list all of the motivations behind their current exercise practice, most listed health and fitness, but half of them also listed fun. Other fun-related reasons included the exercise being a hobby, a way to socialise, and the desire to be more attractive to the opposite sex. Health- and fitness-specific motivations were weight loss and a training regime (see Figure 4-1).

Of the 14 respondents who cited socialising as a motivation, 12 of them exercised with others or in groups. Despite socialising only being identified as a motivation behind exercise by 28% of the respondents, only 24% exercised alone. All of those who exercised with others identified many motivational and subsequently physical benefits that were lost when exercising alone. These included enforced discipline and responsibility, exercise that was more fun or less boring, friendly competition and increased confidence.

Reflecting the findings of the questionnaire, the most common motivations for current and desired levels of physical activity were health and fitness. However, during the interviews it became clear that the terms health and fitness held multiple meanings. Exercise was often seen as an investment in the future, a preventative measure to promote health in the

long-term and later life. Interestingly, it was also viewed as a compensatory mechanism; a way to counterbalance less healthy lifestyle choices (smoking, drinking, "bad" diet) that participants hoped to change in the future, or more commonly, did not want to change.

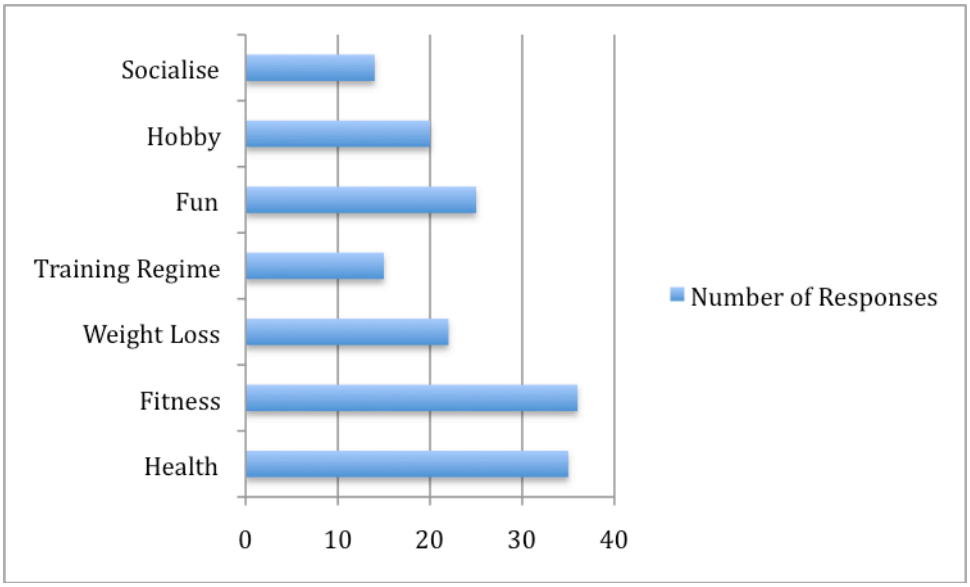


Figure 4-1: Motivations to Exercise

For those citing fitness as a motivation, exercise was commonly considered to be an intrinsic part of daily life. In addition to those who wanted to keep fit so that they could progress and/or compete at a sport (either formally or informally) P6 hoped to join the army upon graduation, and so maintaining and improving his own fitness was essential to him. It is here that the biggest contrast between those who view exercise as a means to an end, and those who view exercise as an end in itself, can be seen. Although keeping fit to participate in a sport may seem like a means to an end, it became apparent during the interviews that the exercise being carried out to facilitate competition/participation was considered an integral, rather than supplementary, component of the primary activity of interest. The goal for these participants was to maintain or improve fitness so that they could participate and improve their own performance. Dips in motivation occurred periodically when the goal was no longer in sight, either due to injury or when the competitive season ended.

Those who participated in exercise primarily out of enjoyment seemed the least susceptible to dips in motivation. They stood in stark contrast to those who were motivated by weight-loss, where aspects of their activities were very much seen as a chore and they were demotivated by boredom while in the gym. Boredom was not unique to those motivated by

weight-loss, but mostly identified by those participating in gym-based activities. Other obstacles to engagement in physical activity included lack of time and poor weather conditions. These obstacles and the strategies employed to overcome them are discussed in the next section.

4.2.4 Obstacles and Overcoming Them

Of the 64% questionnaire respondents who felt that they didn't do enough exercise, 87.5% of those identified lack of time as a major barrier to any increase in participation. Other obstacles included the inability to find an exercise that they enjoyed (40%), general apathy towards the need to increase exercise levels (18%), and intimidation at the thought of joining clubs and/or going to the gym (9%).

As just mentioned in the previous section, boredom was cited as a demotivating factor by each of the interview participants who were exercising to lose weight and those whose primary location for exercise was the gym. The only other participant to mention boredom was P9, an endurance racer whose training consisted of running and cycling sessions of multiple-hour duration. For him, an MP3 player provided much needed distraction, and a prescribed training programme helped him remain focused on the steps needed to achieve his goal. P8 also found that having a programme helped her adhere to the three gym sessions per week that she chose to participate in. MP3 players were used by the rest of the "bored" participants while exercising in the gym.

The desire to find alternative sources of stimulation seems to be derived from the relative lack of external stimuli provided in the gym environment during activities that are conventionally practised outdoors. Apart from the endurance racer P9, those who did participate in outdoor activities purposefully avoided using MP3s because the very use of them would detract from the experience of being outdoors. One participant reflected on his one and only experience of listening to music while running:

> *Well it was alright, but I like to know what is going on around me. I like to have a nosey as well, listen in on people's conversations. And outside I like listening to birds and things.*

In contrast to the use of a prescriptive training programme to channel focus and the use of an MP3 to alleviate boredom, an alternative strategy employed by several of our participants was to take part in multiple activities to prevent getting bored. Not relying on

one source of exercise meant that participants could periodically modify an exercise regime, or avoid falling into a routine at all. The subsequent flexibility that having more than one source of exercise affords also meant that participants were more likely to be able to fit their exercise around the demands of daily life in a way that those who relied solely on the gym, for example, could not. Less flexible participants were therefore less equipped to overcome temporal barriers to exercise, the most commonly cited obstacle to exercise in our earlier questionnaire. It could however be the case that it is the level of an individual's commitment that is indicative of the effort an individual will expend on fitting exercise into their weekly routine; having multiple options just makes the task easier.

The gym does offer some benefits to those who attend over non-gym-based alternatives. When compared to the opportunities to play team sports or to go hill walking, the gym is much more accessible to many as people don't have to rely on others to go and bad weather does not prevent attendance. Almost uniformly our participants expressed a preference for performing exercise with others, but difficulties in scheduling convenient times were often prohibitive. One strategy to overcome this was to participate in exercise classes, whereby the presence of an instructor and other peers provided the social stimulation and motivation desired:

> *I prefer to exercise with other people. There is more motivation, it is more fun... Because the gym is so boring. I mean I know there are some people that like the gym, and there are others that go just because it is good for you. But I just find it very, very dull.*

Apart from difficulties in arranging convenient times, another potential problem with performing exercise with others was found to be finding exercise buddies of similar abilities. To a degree this problem is of more importance to those who are training for competition rather than just exercising to remain active, as performance is of optimum concern. Unlike P9, P8 seemed to be happy to trade exertion for sociability:

> *I find running with someone else is so much easier. I mean as long as they are somebody who doesn't run faster than you it is fine. As I say I go out with Shelley, who probably runs about the same speed as I do now. I think I probably was faster than her when I was younger. Her pace is fine for me now. The other lady that I go out with isn't as fast. And I find that my breathing hardly goes up, I don't get out of breath when I am running with her because she is so much slower.*

4.2.5 Discussion

From a small investigational survey into exercise practice and related motivational issues it is not possible to make broad-spanning claims of how technology should be designed to encourage exercise participation. We have to acknowledge the element of self-selectivity that is involved in voluntary participation in web-based surveys and interviews. While in the survey there was evidence of individuals participating who were disinterested in physical activity, all of our interview participants engaged in some form of concerted effort to exercise, albeit at varying degrees of intensity and frequency. So when thinking of how this has influenced our findings, we cannot suggest that we have gained insight into the obstacles that prevent an individual engaging in attempts to increase their level of activity. What our findings do provide is an insight into the obstacles and motivations of those already or previously engaged in the process of behavioural change.

Time, the most commonly cited obstacle in the survey, was indeed a pressure for all of our participants. Supporting Morris and Choi's [178] suggestion of self-motivation's influence on time being a barrier to participation (see Chapter 2.2.1), what we found though was that those participants who regarded exercise as a hobby rather than a means to an end were more willing to invest effort in adapting their exercise regime around the temporal demands of daily life. Boredom was mostly associated with exercise sessions at the gym. In those cases the use of MP3 players and participating in group classes provided much needed distractions. Almost all of the interview participants expressed a preference for exercising with others where possible, although this was sometimes at the cost of the intensity of the workout. A barrier for some of our participants to participate in exercise with others was again temporal in nature: difficulties in scheduling appropriate times to meet. Indeed, for those who did use the gym a major benefit was the fact that it was always available.

Given our findings, the following factors were found to contribute to the participants' motivation to exercise and should be considered when designing motivational tools:

- Sociability: is an important aspect of exercise that is often overlooked in favour of the direct physiological benefits.

- Variability: not only do the preferences of individuals differ, but also those who do regular exercise often do a combination of activities to prevent their routine

becoming monotonous. Systems could account for such variability in preferences and routine, rather than concentrating on promoting one activity.

- Opportunism: lack of time has proved to be a major perceived barrier to increasing activity levels. Rather than creating a system that makes inappropriate demands on a user's time, a system could highlight the potential for opportunistic activity.

On the whole the most engaged participants were those who did not rely on the gym for their source of exercise. Indeed, in 2005 market research found that only 27% of UK gym members actually attend their gym on a regular basis[14]. While there are already ongoing efforts to augment the gym environment [174, 183, 193], we suggest that a more fruitful focus is to promote physical activity within everyday life. Everyday life lends itself much more easily to sociability, variability, and opportunism than the constrained gym environment.

4.3 Shakra: Tracking and Sharing Daily Activity Levels

In the previous section we found that many of our participants were placed at opposing ends of an activity continuum. While those who relied on gym-based exercise seemed to have allocated that time as exercise time, others integrated exercise into their everyday routine, either engaging flexibly in activities depending on the time they have available or purposefully introducing physical activity into their commute. Inspired by these findings and the earlier discussions of public health policy, a second study focussed on potential improvements that can be made to people's physical activity levels by making small changes to their everyday routine. A system was developed that tracked and shared daily activity levels between groups of friends. As well as investigating user responses and reactions to the system with regards to their activity levels, the evaluation of Shakra explored how people responded to being tracked in such a manner and having their data shared between friends.

Shakra was designed and developed in collaboration between members of the Glasgow and Bristol Equator groups. The author was involved in the design, implementation and evaluation of the system alongside Scott Sherwood, Malcolm Hall, Louise Barkhuus, and Ian Anderson; specific contributions will be identified within the following sections. The

[14] http://www.bmrb.co.uk/news/article/the-guide-to-gym-members/ [last accessed 15/02/09]

author drove the concept and design of Shakra. The author implemented the GUI. Scott Sherwood and Malcolm Hall implemented the web server components, and mobile phone-based web service client and local store. Ian Anderson implemented the GSM and activity monitors. Louise Barkhuus carried out the user study; the author assisting with interviews and data analysis. Much of the remainder of this section is based on the publications on which the author was first or second author [10, 159]. An overview of the study (interview schedule, study participants) can be found in Appendix 11.3.

The primary goal behind Shakra was to develop a lightweight physical activity awareness system that included aspects of the three overriding themes that emerged from the motivational issues survey described in Section 4.2.5: sociability, variability, and opportunism.

4.3.1 Design

The overall aim was to design and implement a system that could help to motivate adults who do not currently achieve the minimum recommended daily activity level, and who can benefit from a raised awareness of their current levels of activity: a system that can track and categorise an individual's daily activity into accumulative time spent in inactivity, light, moderate, and vigorous activity. In acknowledgement of the already discussed influence that social networks can have on the actions of an individual, the system should facilitate the sharing and comparison of data between peers. A working prototype was created that determined whether a user was active or inactive, accumulated daily totals, and allowed the sharing and comparison of the daily totals.

A key design goal for Shakra was that it could be carried around in a non-intrusive manner, requiring little or no extra equipment for users. Minimal user intervention is required in order for it to function effectively; the system tracks the activity of the user without direct manual input. The application tracks users' general level of activity, showing the current mobility state: no movement ('stationary'), moderate activity ('walking') and travelling in a car, bus or train (collectively labelled here as 'driving'). The moderate activity is then used to display a 'minutes of activity per day', with a historical view supporting comparison of activity across the previous week. This supports a user monitoring his or her own activity and exercise levels; with the exception that stationary exercise (such as working out at a gym) is not tracked.

When running the application for the first time, the user is prompted to provide a name, used to identify him or her within the system and to other users. The application records up to seven visible GSM cells and their signal strengths once per second. The current activity of the user is then classified every 30 seconds by the application's neural network, as described in more detail below. Using a web service, each phone uploads the recorded activity of the user via GPRS and stored on a MySQL database, while simultaneously downloading information about other participants for later review. The system updates this shared information automatically every hour. If a user does not want to wait for an update, he or she can manually synchronise via the Sync menu option.

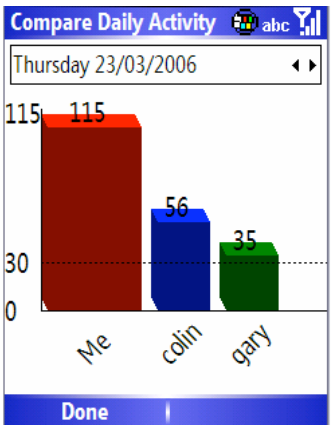


Figure 4-2: Shakra Screenshot Compare Daily Activity

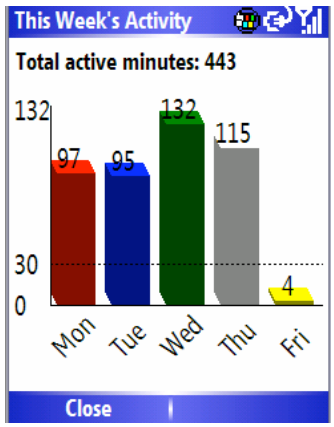
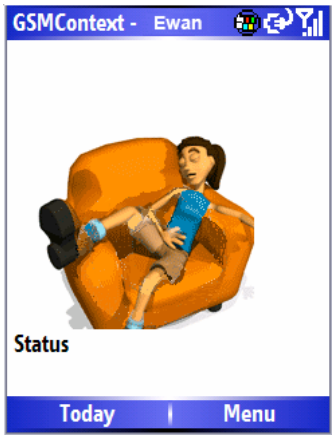


Figure 4-3: Shakra Screenshot This Week's Activity



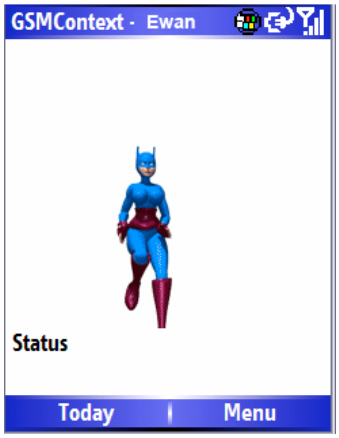


Figure 4-4: Shakra Screenshot Estimated Activity Stationary (left) and Walking (right)

Users specify in advance the peers they wish to share results with, but at any time they can change the list of peers whom they wish to exchange information with. Figure 4-2 shows the Compare Activity screen that users can view to assess their performance in relation to their peers. For a week's overview of their own activity, users may use the Week's Activity screen shown in Figure 4-3. In order to provide real time feedback to the user an animated representation of the user's current mode of activity runs continuously on the main screen of the application (Figure 4-4). For details of how Shakra was implemented, please see Appendix 11.1.

4.3.2 User Study

Shakra was evaluated with three groups, to detail its use, to determine whether it increased users' awareness of their activity level and if this could potentially motivate them to be more active, and to derive implications for future work. Naturally, a longitudinal clinical study lasting months or years would be needed to rigorously assess long– term changes in users' behaviour and health, but our one week trial served as a pilot evaluation. The focus was on the users' experiences with both the activity tracking and the sharing feature; it was important to find if sharing information was good for increasing awareness and motivate a more active lifestyle.

Before the trial, a base neural network had been constructed by using GSM data collected by the development team while sitting still, walking, and driving. In order to determine whether or not further personalisation of the network was required for each of the trial participants, the system was given to each participant for a two-day training period. During this period, the participants were asked to record whenever their activity mode changed. Functionally, this was a simple task supported in the application's main interface, which users quickly learned to perform. For the training days, we asked the participants to take the phone with them as they went about a normal day's activity. This trained the system for the areas in which they were usually active throughout the course of a day.

Following the initial system-training period, the data collected by the trial participants was analysed. We found that only minor changes to the previously trained neural network were required by three of the nine volunteers. This was due to them living and working in urban areas that exhibited different levels of signal fluctuation to those where the initial training data had been collected by the research team.

4.3.2.1 Method

Overall, the trial took place over ten days. The participants initially filled in a simple activity diary for three days, to determine their present level of activity and to compare activity to the week of using the application. Immediately after, they trained the system for two days and then finally used the system for a five-day working week, filling in a diary describing their use of the system and whereabouts for each day. We kept in touch with the participants by phoning them once during the week, and sending text messages in the few cases where it looked like the phone was not uploading properly. At the end of the study, each participant was interviewed individually to expand on the use and reflect on the experiences with and opinion of Shakra.

	Group 1	Group 2	Group 3
Number	2	3	4
Age Range	52-54	28-30	19-37
Gender	Mixed	Male	Female
Activity Level	Fairly Inactive	Two Moderate, One Highly Active	One Inactive, Two Moderately Active, One Highly Active
Occupation	Teacher and Administrator	Technical Administrators	Manager, Admin Staff, Student

Table 4-1: Shakra Participant Demographics by Group

The participants were recruited as groups of friends and/or co-workers who had daily interaction with each other and would enjoy sharing their exercise information. We aimed to study the use of the system among a diverse set of people, and the nine participants varied in the degree of their normal activity. Two were highly active, with purposeful exercise at least three days a week, four were moderately active people, working out one to two times a week, and three were fairly inactive, walking but not doing any purposeful exercise. Table 4-1: Shakra Participant Demographics by Group provides an overview of the three groups.

After the study, the system logs were analysed. First of all, the activity times were compared to the self-reported diaries and the interviews, to make sure there was a fair level of accuracy in measuring activity. Secondly, the logs were scrutinised to see how participants used the application, how often they compared their activity to others', and how often they looked at their weekly chart. The interviews were transcribed immediately and the parts were categorised according to major topics and themes. They were used to elaborate on the diary, such as precise times of commute, actual transport methods and

more detailed experiences and impressions of the application during the week. In the next section, we report the results in relation to three topics, one relating to precision or reliability of the application's measurements, a second looking at users' individual experience, and the third exploring the participants' experiences of information sharing.

4.3.2.2 Reliability of Shakra in the Real World

Although previous tests had shown highly accurate determination of activity [11], the real test of the application would be using it in an uncontrolled environment among many different people. We did not expect to get such high accuracy, because of the unstructured and diverse behaviour of people leading their everyday lives.

Overall, the application showed very good determination of activity and the participants found it very useful as a tool for measuring their activities. After analysing the diaries and annotating them with information gained through interviews, we compared each day of each participant with a log–generated activity timeline. It was easy to see participants commute to work, break for lunch, and commute back from work; two examples, with diary annotations, are shown in Figure 4-5. A rough analysis was done to determine the rate of correct labelling of activity. We chose three sample days for two different participants because their diary entries for those days were particularly comprehensive, i.e. six days in total. From the unfiltered data we analysed short stretches of 60 to 90 minutes with varied activity; this was done to refrain from considering the long hours of inactivity, which occurred during their workday where participants were mostly sitting at their desk. Including this would have given unrealistically optimistic numbers. Results showed a minimum of 70% accuracy during users' commute when fluctuations are highest. The misinterpretations often occurred during change between different methods of transportation such as getting off a bus or a train. However since it would often have delay both before and after transportation, the misinterpretations would cancel each other out and therefore correcting the accumulated minutes of exercise. One more problematic finding was that running occasionally would register as driving. During one participant's 45-minute lunch run, 15 of the minutes were registered as driving. For another participant with a long commute for example, it meant that he gained a maximum of seven active minutes each day due to error. This was the maximum error we found from looking at participants' commutes.

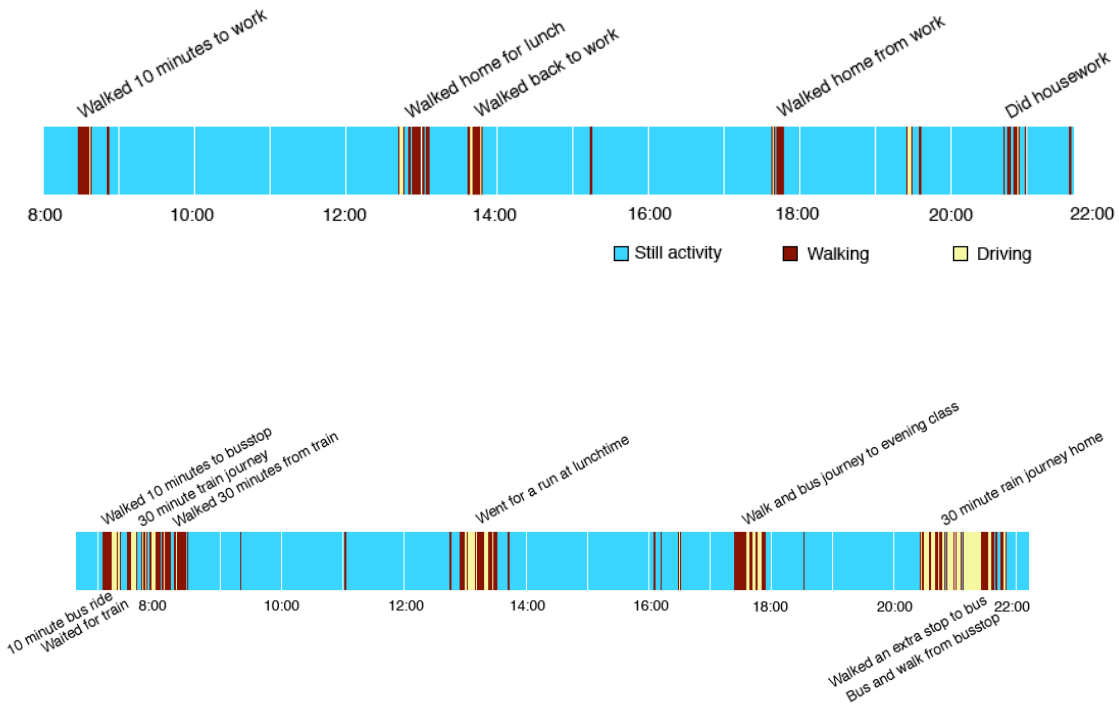


Figure 4-5: Example daily activity timelines with colour showing inferred activity level and text showing participant's diary annotations

Some of the diary entries assisted in showing when still or walking activity was misidentified. For example, one woman from group 3 explained that she went on a walk for 30 minutes, but had only increased her overall activity count by 22 minutes when she returned. It should be noted that this particular participant lived on the countryside where we knew that the neural network would be less accurate in the present version. Similarly, a male participant reported that his 10-minute walk to work sometimes only gave him seven or eight minutes of activity. This may in part be attributable to a lag in activity determination as well as the participants stopping at road crossings, etc. Since the application is aimed towards increasing awareness rather then measuring physical exercise precisely, and offered useably accurate overall measures, we suggest that the small moment-by-moment lags and jitters in classification were not problematic. Post-processing may be able to trim such errors, but this is an area for future refinement—a topic we return to in Section 4.3.3.

4.3.2.3 User Experience

The participants all took the phones with them every day, carrying the phones around with them wherever they went for the vast majority of the day. The application was found to be

both reliable and stable overall, and everyone found it easy to use. Where group 2 had the chance to use it during most of their working day and therefore checked it and compared extensively (between 11 and 34 times a day), the other groups had busy days where they would mostly check their numbers and compare in the evening, therefore checking fewer times (between 1 and 20 times).

Participants reported that the application was fun to use and gave them good— and sometimes surprising—awareness of their activity levels. Two participants (from group 2 and 3) reported it to be highly 'addictive', in particular the sharing aspect. Another participant repeatedly explained how it made him see how 'lazy' he was. Only one participant felt that he was misrepresented by the tracked activity in the application, although this did not concern him because he attended the gym four times per week and was aware that his friends knew this. It was interesting to see the recurring mentality that gym-time was 'the' allocated exercise-time that we observed in the earlier motivational issues survey (Section 4.2). This participant suggested that an application such as Shakra was more suited for people who do not attend a gym:

> *It is a good idea for people who would be less inclined to maybe doing any exercise. They maybe don't go to the gym. It would be good for people like that.*

Although only four of the nine participants reported doing more activity than usual in the interviews (and attributed it to the application's sharing functionality as well as more general competitiveness), the diaries show that the other participants were also more active compared to the initial three day 'base' diary. The short-term nature of this pilot study does not allow for observation or inferences to be made about the initial novelty value of the system. Indeed, the purpose of this study was not to measure behavioural change but to gauge user responses and reactions to the system. As we discuss further in Section 4.3.3, a longitudinal clinical trial would be needed to determine long-term use and effects. The following sections now describe some of the nuances observed with respect to individual use and motivation, and the shared experience of Shakra.

4.3.2.4 Individual Use and Motivation

The participants described how they would enjoy checking how much walking and running activity they did during the day. Most of them checked their own minutes regularly and were astonished how they gained minutes during busy days. One woman from group 3 was

surprised that she had accumulated 177 minutes one day, but when looking back though the diary, she realised that she had been busy commuting between two different work places (which involved walking to and from a bus and a ferry), as well as walking her dogs in the morning and evening. We were able to detect most of her activities in the data log, except for some of her transport that had a few small gaps of 30 seconds walking when she was in fact driving. This error, however, did not add more than seven minutes of walking to the whole day. This participant was busy and already highly active, and did not feel the application had made her change her activity level during the study.

One participant from Group 2 on the other hand, was very active that week in particular, and attributed this to the application. He explains how he increased his activity that week:

> *[I]t probably encouraged me to go running Monday, Wednesday and Friday, because I always have the intention of going running at the beginning of the week. […] and I sort of set out Monday, okay right, I will take my stuff and I will go, you know, just Monday, Wednesday and Friday. [It also encouraged me to] just walk a couple of extra bus stops.*

He was very keen on increasing his activity level, and had tried to get into running three days a week for a while, without complete success. The weather had sometimes deterred him before, but with Shakra, he went out every planned day despite it raining on two of those days.

Although the participants seemed to be motivated from just the awareness of their activity, the effect was not unanticipated; often merely the knowledge that others can detect one's activity (either from a filling in a diary or from using a tracking system) makes one more active. However, it was important to explore whether the use affected users' awareness and attitude towards moderate activity. Behavioural change is a slow and often long-term process but the necessary first steps have been taken here in that awareness and motivation increased. Other issues affect motivation and awareness in return; therefore it should be related to social factors such as competition and collaboration – as the next section discusses.

4.3.2.5 Shared Experience

The groups did not only enjoy the increased awareness of their individual activity levels, they also enjoyed the mutual awareness of each other that the system facilitated. The consequences of the shared awareness varied between and within the groups, both in the

ways they responded to the shared information, and the focus that they placed on the shared information itself.

While competitive tendencies could be found to varying degrees in Group 2 and Group 3, Group 2 were the most explicitly competitive. Group 2 were quite determined in their competition, in particular one participant who would spend much of his working day walking around taking calls on his wireless headset, much more than he usually did. One of his group members explains:

> *[We] would be sitting in calls and he would be walking by [showing the phone to us]. Maybe there was a meeting round that side of the building (pointing), he would walk all around the building to get there (the building is doughnut shaped) … Me and Colin would sort of check more often to see. Ewan just rubbed it in front of our noses, how far he went.*

This group enjoyed the competition despite a very different number of accumulated active minutes. Since the 'overachiever' described above had a wireless headset and was not confined to his desk, he could work while walking around—or walk while working. The other two group members were more confined to their desks during the day and only reached about half of his minutes every day. Where the first of these two said that he realised how 'lazy' he was, the second participant explained that he did not care that much, since he worked out at the gym about three times a week. As discussed earlier he was quite content with his activity level, and did not see his ten-minute walk to and from work as 'exercise'. In this case there was more concern from the less active of the two, who did report making a concerted effort on a couple of occasions during the pilot-study to walk to the shop instead of driving as he usually did. Although his efforts were constrained, by his own admission, by his laziness, he pointed to external factors such as busyness at work on particular days as restricting his opportunity to exercise on those days.

Group 3 also had one member who was much more active than the other members, but in contrast to the most active member of Group 2 she had not consciously changed her routine in order to stay ahead of the others. And while she did express a keen interest in the application and in particular being able to see what her friends' activity had been, the thought of competition within the group did not seem to have crossed her mind: "It didn't make me think, alright I gotta go out... it could if you were maybe having a sort of competition. But I didn't do anything extra because of that."

Despite others introducing competition into the user experience, for this participant it needed to be made explicit within the dynamics of the application. One of the other members of Group 3 did express a competitive response to Nina's high levels of activity. For example, one evening when she came back from a run with 112 minutes, she saw her friend had 177 minutes of activity. In an attempt to catch her friend up, she asked her neighbour if she could take the latter's dogs for a walk. She therefore managed to get 137 minutes, when she realised that Nina still had more she reported thinking "damn... what can I do now... haha". In contrast, Megan did not try and compete with Nina but instead she would look at how active she had been in relation to the rest of the group and then increase the activity levels according. In this case the application was not used competitively, but as a benchmarking tool. What was interesting about Megan's use of the system was that she was the only participant who did not look at all of Group 3's activity levels. She already knew that Nina was the most active of the group and chose only to look at Nina's activity levels, and used them to set her own daily goals.

Group 1 did not compete, but they did enjoy the fact that they could see each other's activity when they were apart. The oldest of the study participants and also a married couple, they mostly used the system to keep an eye on their own activity levels. They were not the only participants to infer the daily activities of others from the minutes of activity presented to them in the application. One of Group 2 in particular enjoyed using the application to "see if any of them were up before me" or if a member "was on his way back from lunch and things like that". Despite the potential for privacy to be infringed in this way, none of the participants expressed any concerns when asked if they felt that the application was too intrusive. One participant did speculate that it might be a problem if, for instance, a boss had access to the system and could tell if an employee had been out the night before (by having accrued minutes of activity after midnight). Another illustration of the impact of social context on attitudes towards the application given in the following statement about the impression that having low activity levels might leave on others:

> *I am not that conscious of how people see how much exercise I do. I suppose ehm, if I was overweight or whatever, if I had an issue or something, but it doesn't really bother me that much. I like to keep fit or whatever, but in relation to how people see me it don't really bother me.*

The fact that the shared awareness was shared awareness between friends was intrinsic to the experience of the application:

> *[The best thing about Shakra was] comparing with your friends. I didn't think I would be checking that but I think that was the main reason I was looking at it.*

Pre-existing knowledge of other group members enabled an individual to prioritise or contextualise the information being conveyed, and the application provided an additional resource for interaction within existing relationships.

The resource for interaction that the application provided went beyond conversation about total minutes walked, to playfulness and banter. Interaction around the system was not limited to those who were participating in the pilot-study. Colleagues, friends, and family members were all reported to have expressed an interest in or asked questions about the system during the study. In this respect raising awareness also went beyond raising awareness of total minutes walked, to raising the issue of physical inactivity to the forefront of participants' and their surrounding peer groups' minds.

4.3.3 Discussion

The development of Shakra was a first step towards creating a low cost physical activity monitor and health promotion application that is easily accessible to the general public. Shakra's real-time collaborative aspects and its lack of sensors beyond the mobile phone differentiated it from other research and products in the area at the time. The initial reaction to Shakra during its pilot study was extremely encouraging. However some issues with accuracy, feedback, privacy and awareness were raised and would need to be addressed in any future implementations.

All of the study participants responded positively towards the system and were tolerant of the momentary lags and jitters in activity classification that were discussed earlier. Many of the participants were excited to see their own activity level, expressing higher motivation and displaying some increase in physical activity. We observed some of the same features that have been seen in more traditional collaboration in exercise to lead to more exercise being done, such as encouragement among 'buddies' and, in some cases, strong competition. The way in which the application was used varied between individuals and groups: it was used variously as a mutual awareness tool, a self-monitoring device, as a benchmarking tool, and as a game. This highlights the need for a degree of ambiguity within the design of a health-promoting system that has a broad user demographic, enabling individuals and groups to use the system in such a way that suits and benefits them. However, the indication that competition would need to be made explicit for some

people also supports the argument for user-specific tailoring. The tension between having an open or more constrained design, and the identification of which types of application design are suitable to certain demographics are areas worthy of further investigation. As will become apparent in the forthcoming chapters, this thesis focuses more on the broader sociotechnical context of health-related behavioural change rather than considering the scope and implications of specific design instantiations.

The technology appears to have been less precise in distinguishing between different types of activity than in the previous controlled experiments [11]. It is to be expected that accuracy might be reduced when used 'in the wild', yet it is our belief that the system can be improved to be more accurate. In the current system, for example, the training period might run for longer so as to account for more of the areas that users go to, or the neural network could be trained dynamically over the course of the application's life. In response to the accuracy issues raised during the pilot-study, a new approach has been developed involving Hidden Markov Models (HMMs), task modelling, and unsupervised calibration; the details of which can be found in [10]. Since this work has been done, mobile phones are emerging which include previously exotic hardware such as WiFi, GPS, and accelerometers. It is likely that the most usable, accurate, and robust solution to activity inference would involve a hybrid of these technologies.

In addition to improving the accuracy of activity inference, the granularity of activity inference must be increased if we are to achieve the goal of implementing a system that can categorise the various levels of activity intensity. As was mentioned earlier, the manual classification of activities into low, moderate, or high intensity levels is not an elementary task. But given improved activity inference and criteria with which to categorise activities it is possible that such classification could be automated. For example, instead of inferring that a user is walking it could differentiate between walking below or above 4 mph, the generic cut off point between low and moderate activity. Similarly work could be done to infer other activities such as cycling, with equivalent distinction between low, moderate, and high intensity cycling. As the focus of the system was to primarily encourage small changes in behaviour, no attention has been made so far to the minimum recommended session length of ten minutes. This could be easily introduced by a post-processing ten minute rolling filter, earning users additional accreditation when a 10-minute session is completed. Another potential avenue of exploration is that of an adaptive system that evolves alongside a user's activity pattern: the 10-minute session accreditation being

introduced when the system detects substantial levels of intermittent activity throughout the day.

As with any pilot study there are limitations to the validity of any resultant claims made. It is not possible, for example, to claim that over a longer period of time the participants would remain enthused and continue to feel motivated by the system. What we do infer from the pilot study is that Shakra is usable and can initiate positive responses and proved to be a resource for interaction used both by participants and those not directly involved in the study. Once developed any subsequent system would need to be the subject of a longitudinal clinical trial to determine the extent of any resulting changes in attitude, behaviour and health.

4.4 Reflecting and Refocusing

Prompted by the increasing attention being paid to the problem of physical inactivity within HCI and related communities, we began our exploration of the topic by considering individual-level motivations and obstacles to increasing physical activity levels. Through our initial survey we found that those most actively engaged in exercise as a pastime, rather than as a means to an end, participated in multiple activities and were more committed to maintaining an opportunistic approach to exercise. That is, when the temporal demands of daily life meant that they could not participate in their usual exercise, they would simply make the most of the time they had available by participating in an alternative activity or for a shorter duration. While strategies of opportunism and variability were only found in highly engaged individuals, sociability was almost uniformly desired as a component of an exercise regime. The benefits of socialising exercise varied from person to person: having strangers and instructors in an exercise class, or having friends to exercise with was a welcome source of distraction, encouragement, competition, and fun.

The idea behind Shakra is that most people can improve their physical activity levels by making small changes to their everyday routine [80, 227]. By aiming to promote changes in an individual's daily routine, the system promotes opportunism. The sharing of activity information between friends introduces sociability. Variability is not represented in Shakra's current form, but the potential exists to extend the activity inference capabilities to monitor multiple activities, as has since been achieved through the Mobile Sensing Platform [65].

As with responses to the comparable systems described in Chapter 3.3.4, responses to Shakra during the pilot-study were positive. However, the differences in use of the system by the three groups of friends raised our awareness of the complexities of social influence; a complexity neither replicated nor accounted for in the design of emerging everyday behavioural change applications. Furthermore, the system proved to be not only a resource for interaction for those participating in the study, but also for their surrounding peers. Given the widely acknowledged influence that social support has on health and health-related behaviour (see Chapter 2.3.2), and the conflicting results with regards to the effective integration of social influence into this genre of systems that was highlighted in Chapter 3.3.5, we decided to further investigate the social dynamics of health-related behavioural change. Additionally, it was apparent that for the most part these systems were being designed for and evaluated by people who were already active or were generally healthy. The practices and needs of individuals who were facing complications or likely to face complications secondary to inactivity were not being considered.

We therefore set out to explore the social dynamics of health-related behavioural change within three populations in which physical inactivity was considered to be a problem behaviour. As was mentioned in Chapter 1, over the course of the studies our focus shifted from the social dynamics of health-related behavioural change to better understanding the nature of everyday behavioural change, of which social dynamics remains a key component. The motivation for such a shift is explained in the next chapter.

4.5 Conclusion

This chapter has presented and discussed two studies that were carried out as initial explorations of the problem of motivating physical activity. Reflecting the overall trend of such work in the HCI and related communities, we considered the problem space from the individual-level perspective. We performed a survey of motivational issues and then designed a lightweight application that tracked and shared daily activity levels between groups of friends. Shakra was well received by study participants and proved to be a resource for physical activity-related conversation between study participants and with peers who were not participating in the study. Such findings further enhance the encouraging findings discussed in Chapter 3.3.5 with respect to the promising future of this genre of application. However, while the introduction of social influence to a self-monitoring application creates an interpersonal-level intervention, the same limitations of comparable systems applied to Shakra: the mechanics of harnessing social influence were

limited and the system had been trialled with relatively healthy and active individuals. This caused us to rethink our approach to the problem space and focus on better understanding the nuances of everyday behavioural change within populations already affected by the problem behaviours that we seek to modify. Before we proceed with the studies themselves, the next chapter introduces the study domains and discusses the methodological approach taken in the remainder of the research that supports this thesis.

5 Methodological Considerations

The previous chapter concluded the first part of this thesis. Part I laid the foundation for the work that will be presented in the forthcoming chapters. The overall argument of Part I is that there is a need to study the problem of health-related behavioural change from the perspective of the individual, rather than the establishment. It was first made in Chapter 2 and further supported by Chapter 3, with respect to the need to develop technology that goes beyond the straightforward emulation or encapsulation of traditional behavioural change techniques. The argument was further elaborated in Chapter 4 through the highlighted complexities of social aspects of health-related behavioural change, and perhaps more importantly, the relative lack of involvement of at-risk or in-need populations in system design so far.

5.1 Introduction

The end of the previous chapter called for the inclusion of populations other than those so far involved in the design of everyday behavioural change technology. We were interested in understanding the social practices of people engaging in health-related behavioural change: the who, what, when, why and how. By focusing on social practices we hoped to generate insight into how pervasive health technology can be better designed to support them, in much the same way that workplace studies have informed the design of CSCW systems. Such a focus can be explained in part by the emerging works at that time and the findings of our initial explorations in the area with Shakra. It was also driven by the

previous work of the research group, which has a strong social emphasis: both in the collaborative nature of the technologies that are developed and in the broader orientation towards the work of Heidegger, Goffman, Garfinkel and Wittgenstein.

Through our initial interest in the social dynamics of health-related behavioural change, we then became sensitive to other aspects of everyday behavioural change that we felt were equally deserving of investigation if we were to contribute to the problem of knowing how to design everyday behavioural change technology that integrates into everyday life (Chapter 1.1). We sought to understand aspects of health and everyday behavioural change as experienced by groups of people affiliated by their socioeconomic status (families at risk), medical history (cardiac rehabilitation) or self-perception (weight management). For reasons explained in Section 5.2 our engagement with the groups' experiences typically took the form of semi-structured interviews. Analytically, we borrowed techniques from symbolic interactionism, using methods advocated by Lofland and Lofland [156] and Strauss and Corbin [230] to make sense of our data.

This chapter commences Part II with a discussion of the theoretical, methodological, and analytical approach that was adopted in the three studies that make up the core of this thesis. The next section provides an overview of qualitative methods and explains the reasoning behind our choice of methods, and then Section 5.3 introduces the studies themselves. The analytic perspective from which the data was approached and the process of sensitisation to additional aspects of everyday behavioural change is presented in Section 5.4. Section 5.5 concludes this chapter by introducing the interpretive framework that is used to structure the findings in the following chapters.

5.2 Qualitative Methods

Although quantitive studies of social networks and social support are plentiful, as was highlighted in Chapter 2, quantitive measures are often the least relevant. Qualitative enquiry is more suited to task of investigating social practices and the experience of health-related behavioural change. As was mentioned in the previous section, semi-structured interviews were our qualitative method of choice. This section describes the merits and limitations of the interviews alongside the other methods that were considered.

5.2.1 Observational Studies

Observational studies allow the researcher to see the actions of a subject and the broader context in which the actions are carried out. In purely observational studies, this leaves the actions open to possible misinterpretation by the researcher, a risk that is reduced somewhat in ethnographic studies by long-term immersion in the environment. There are two modes of observation, direct and indirect. In direct observation, the researcher is present in the subject's environment and watches the subject go about their everyday routine or perform a particular task. With no mode of recording the events that are being observed, one limitation is that events of interest may be missed by the researcher [216] and that there is no way to revisit the data [197]. Indirect observation alleviates that problem, as it is typically done via video recorder. However, it does not address the limitation of data collected only being that which can be observed; tacit knowledge and influential experience cannot be accounted for when relying on observation alone [215].

Using a video recorder also potentially reduces the visibility of the researcher, thus attenuating one of the most commonly stated limitations of observational studies—the Hawthorne effect:

> *Proponents of the Hawthorne effect say that people who are singled out for a study of any kind may improve their performance or behavior not because of any specific condition being tested, but simply because of all the attention they receive.[205].*

Such a view seems to indicate that the degree of attention paid to those participating in a study is positively correlated with any subsequent Hawthorne effect; a commonly held assumption being that the no human-centred study is completely free from the Hawthorne effect [158]. However, the generalisability of the Hawthorne effect has recently been called into question [158, 205]. Macefield [158] presents a full discussion on the limitations of such a generalisation with respect to usability evaluations. Similarly, Crabtree and Rodden [75] propose that the Hawthorne effect is often overestimated when considering ethnographic studies in the workplace and home, simply because when in these environments people "have better things to do than impress or worry about the ethnographer".

We decided against observational studies because of the temporally and spatially disparate nature of the phenomenon under consideration. Interviews allowed us to gain access and

insight into the experience of health and health-related behavioural change that would have otherwise been difficult or impossible to observe.

5.2.2 Interviews

There are many limitations to interviewing as an investigative technique, the most obvious being the widely acknowledged discrepancy between what people do and what people say they do. Interviewees may also tailor their answers to suit what they think the interviewer wants to hear or to pursue their own agendas [197]. A less obvious limitation is that interviewing relies on a degree of reflective expertise on the part of the subject, and the ability to articulate their thoughts, feelings, and experiences. Additionally, the questions that are asked are limited by the assumptions of the researcher. While this may be useful in situations where the research question has a narrow focus, in more exploratory studies this may delimit the subsequent scope for potential and valuable findings. The implication of incorrect assumptions is most damaging in structured interviews, in which the researcher follows a script of predetermined questions with no opportunity for deviation, clarification or explanation. Semi-structured interviews offer some purchase on this problem in that the researcher enters the interview with a loosely defined schedule and willingness to let the course of the interview be guided by issues that are raised as relevant by the subject.

However, in addition to the benefit of being suitable probes into temporally and spatially disparate phenomena, interviews also enable researchers to gain insight into the attitudes, emotions and opinions of subjects that may not otherwise be easily observed [197]. One of the important merits of interviews, with respect to this thesis, is that they place relatively low demand on subjects, making them a good methodological choice when attempting to recruit difficult to reach populations.

Essentially, the determining factor behind the choice to use semi-structured interviewing was the impracticality of employing observational methods to investigate geographically and temporally disparate phenomena. One alternative method being offered by HCI is that of Technology Probes [130]. However, as will be discussed in Section 5.2.4, we found them to be unsuitable for the purpose of this research.

5.2.3 Focus Groups

The focus group methodology originated in the commercial market research domain [114], but has since been adapted for academic research. As a standalone research activity, focus groups can be used to discover the group processes and normative influences that lead a group to come to collective judgements [38]. However:

> *When it comes to documenting behaviour, focus groups are less suitable than individual interviews: there is an understandable tendency for atypical behaviours to be unreported or under-reported in group settings*. [38]

The unsuitability of focus groups as a primary method for this research was further exacerbated by the potentially sensitive nature of the topics that would be covered (for example, health). However, it is common for focus groups to be used "for exploratory purposes, to inform the development of the later stages of the study" [38]. We decided to use a focus group in the initial phase of the Families at Risk study. The reasoning behind the use of a focus group in that particular study was in part because the cultural disparity between the author and the participants that was greater than in the other two studies. The focus group reduced the visibility of the author while the discussion took place, allowing her to familiarise herself with the concerns of the participants before engaging in more intensive one-to-one interactions. An impromptu focus group was also carried out during the Weight Management study when the interviewer arrived at a participant's house to perform an interview to find the participant had invited three of her friends along to join in.

5.2.4 Technology Probes

Technology probes are an increasingly common approach to studying 'difficult to observe' phenomena. They are an extension of Gaver et al's [104] cultural probes whereby the probes themselves are technological artefacts. Hutchinson et al [130] introduced technology probes as:

> *A particular type of probe that combines the social science goal of collecting information about the use and the users of the technology in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and designers to think of new kinds of technology to support their needs and desires.*

The use of technology probes within the health domain is inarguably in its infancy, but the approach has successfully been applied to investigating the self-management practices of individuals with diabetes [162] and the adoption process of assistive technology [78].

It was thought that they would provide an ideal medium through which to study such a complex area as social support within cardiac rehabilitation: an area that covers geographically and temporally disparate phenomena. We could not observe the daily interactions between peers, but we could deploy a technology probe that might provoke reactions, stimulate discussion and provide a resource for interaction around the behavioural change, which could be elicited and expanded upon through quantitative analysis of the probe's usage logs and qualitative information gathered in periodic in-depth interviews.

For the cardiac rehabilitation study we developed a technology probe, Collabohab, a multimedia collaborative rehabilitation journal (see Chapter 8.4). While recruiting for the pilot study it became apparent that deploying a lightweight social networking application into this population was not appropriate. Collabohab was designed as a probe to reveal information disclosure practices throughout the course of the rehab program between friends and family members, fellow rehabilitation peers, and rehabilitation staff. Unfortunately, the probe itself proved to be a significant barrier to recruitment and those who were recruited didn't have the opportunity to interact with peers through it, and chose not to involve friends or family members. In this sense the probe did not serve its purpose; nothing related to the initial objectives of the study was learnt from its use. Given the outcome of the pilot study we decided to continue our investigations without the technology probe, relying instead on semi-structured interviewing. This way, we were able to explore the original aims of the study alongside the questions raised during the pilot with a broader demographic of rehabilitation participants (a further benefit of interviewing as a qualitative method). For further details of the design of Collabohab and the decision to withdraw it from the study please refer to Chapter 8.

5.2.5 The Role of Qualitative Enquiry in this Thesis

Unlike most of the qualitative work in HCI, we are not concerned with studying the use of technology, but rather studying populations who *may* benefit from recent technological advances in the field—sociological research does not need to address technology at all in

order to contribute to system design [88, 215]. Within this thesis, as suggested at the beginning of the section, the motivation behind the studies is to provide understanding of everyday behavioural change, and subsequently insight into how better to design technology to support it. However, we found that while it was possible to draw some implications for design—presented in bullet form in the conclusion of each study's chapter—the data raised what we considered to be more pertinent questions with regards to HCI's current approach to the problem space. As such, the findings of each study are considered alongside a critique of existing technologies. The studies within this thesis have provided a new lens through which to view the assumptions and values embodied in work emerging from this field (see Chapter 3); that is the role of qualitative enquiry in this thesis.

5.3 The Studies

Our choice of study domains was at once strategic and opportunistic. Reflecting our belief that existing work was not sufficiently addressing the surrounding sociomedical context of health-related behavioural change, we sought to highlight the diversity and complexity of the problem space. The three studies considered everyday behavioural change in weight management (WM), cardiac rehabilitation (CR) and families at risk (FAR). Although each is distinct with unique characteristics, they are related by their common ties to physical inactivity and poor dietary intake.

In the studies where there was a central locale that all participants were affiliated with, the author did spend a period of familiarisation. All study participants were given the option of being interviewed at home, at a location of their choice, or at an affiliated institution such as the community outreach project (FAR), a hospital (CR), or a university office (WM/CR). All of the interviews were semi-structured in that they followed a broad schedule, but allowed for topics to be explored as they arose. Roughly speaking, questions revolved around health, dietary intake, physical activity, social networks and change. All of the studies shared similar schedules, with a degree of tailoring for each of the domains. For example, participants in the cardiac rehabilitation study were asked about the cardiac event that led to their participation on the cardiac rehabilitation programme, and families at risk participants were asked about the activity levels of their children.

When deciding how many participants to recruit, researchers are faced with the question of how much is enough? Qualitative textbooks advocate sampling until saturation has been reached, but the finite timescale of the individual studies and the PhD itself rendered such an approach impractical. Another approach is to look to the field to find the acceptable sample size. In their review of publication trends in CHI, Barkhuus and Rode [23] found that the average sample size for qualitative research was fourteen. We therefore aimed to recruit twenty participants for each study, eventually recruiting between seventeen and nineteen. Our recruitment strategy differed for each of the studies, as is described below.

There was a significant degree of overlap in the lifetime of each study. As such, no one study informed the design of another. This was not the case with the analysis of the studies, as is discussed further in Section 5.4.1. The following sections explain the motivation for studying these particular sites of behavioural change, our methods for gaining access and recruitment techniques and, where applicable, the process of familiarisation.

5.3.1 Weight Management

The decision to investigate weight management was prompted by the fairly consistent citing of overweight and obesity as motivating factors for much of the existing work in HCI and related domains, and the fairly consistent omission of overweight or obese participants in the design or evaluation of subsequent systems. Initially, we approached several weight loss organisations that all declined to collaborate. We eventually decided to independently recruit people with weight management experience, which we feel benefited the subsequent study by affording a broader perspective of weight management. Upon reflection it is interesting that we instinctively approached weight loss organisations, which perhaps demonstrates our own exposure to mass media and the marketing of commercial weight loss programmes.

5.3.1.1 Recruitment

Interview recruitment posters were created and displayed in several community centres, shop notice boards and within the university. They invited individuals who considered themselves to be overweight, or had been in the past, to talk about the ‘things’ and people in their life that made it easy or difficult for them to lose weight. The initial recruitment drive resulted in fourteen respondents. As many might expect, the majority of the fourteen

participants interviewed were female (10). In an attempt to recruit more male participants, we sent an email to a university mailing list containing the same information as the initial recruitment posters but specifically requesting male participants. From this email we recruited a further four male participants, one of whom recruited his wife.

5.3.2 Families at Risk

The Families at Risk study was made possible through the department's Ken Browning Scholarship which funds PhD students working in the area of computing and medicine to do research abroad. The author approached Dr. Siek at the University of Colorado at Boulder, who she knew worked in pervasive health to discuss the possibility of collaborating on a suitable project. Dr Siek had recently established contacts with the Bridge Project, a community outreach project situated in a community in which a recent study had found that 87% of preschoolers were exposed to at least one modifiable risk factor for cardiovascular disease; the two most common risk factors being poor dietary intake and physical inactivity [24]. The Families at Risk study provided a further contrast to the other two studies in that it addressed preventative behavioural change, considered the behaviour of a family unit, and raised socioeconomic status to the fore in a way that the weight management and cardiac rehabilitation studies did not.

5.3.2.1 Familiarisation

After the Bridge Project management team agreed to collaborate on the families at risk study, the author spent time at the centres answering questions that the staff had about the study and familiarising herself with the centres, their activities, and the children—and enabling them to familiarise themselves with her. She spent time helping clean dishes, putting deliveries away, helping the preschoolers in their IT sessions, and helping the middle-schoolers during homework hour. Formal collaboration with a trusted party eased recruitment of participants, while informal familiarity helped to establish a valuable rapport with the family caregivers once they were recruited.

5.3.2.2 Recruitment

Our collaboration with a trusted resource in the community proved invaluable in the recruitment process. We worked with administrators from the Bridge Project to recruit primary caregivers of children under eight years old who lived in the public housing

community and spoke English. Responses were extremely positive and out of a recruitment pool of twenty-one, a total of seventeen were recruited for the study.

5.3.3 Cardiac Rehabilitation

Cardiac rehabilitation is an interesting domain to consider health-related behavioural change because it is always preceded by an acute health event such as a heart attack or cardiac surgery. All cardiac rehabilitation participants attend the structured clinical programme that, over a period of weeks, offers an incentive and focus that may not necessarily exist in 'everyday life'. Cardiac rehabilitation was suggested as a possible domain of interest by one of the author's secondary supervisors in the university's School of Medicine. Through her contacts we arranged a meeting with the management of the cardiac rehabilitation service who agreed to collaborate with the study.

5.3.3.1 Familiarisation

During the cardiac rehabilitation pilot-study, the author spent time with the staff, explaining the purpose of the study, and then participating in the cardiac rehabilitation programme herself. The purpose of her presence was twofold: to familiarise herself with the organisational structure of the programme and also to be present to deal with any technical issues that participants might have had with the probe (a condition of the ethical approval for the study). However, a month into the pilot study the author felt that her presence applied pressure on prospective participants who she had got to know during the classes. One of the prospective participants was extremely apologetic when she decided not to take part because she felt technically unable, but felt bad because she knew the study was "for" the author. Wanting to avoid placing rehabilitation participants under unnecessary pressure, from that point on the author stopped participating in the rehabilitation classes, instead making herself available to the study participants for questions at the end of their classes.

5.3.3.2 Recruitment

The rehabilitation staff recruited cardiac rehabilitation participants. Due to the conditions of the ethical approval, the author was not allowed to speak to rehabilitation participants about the study until they had read the information sheet given to them by the rehabilitation staff. Although this proved not to be a problem for the main study (nineteen

participants were recruited for the main study), we feel that this may have contributed somewhat to the problems recruiting for the pilot study. As mentioned earlier, the author had spent time with the rehabilitation staff explaining the purpose of the study and showing them how to use the probe, but unless familiar with the concept and purpose of a technology probe and the technology probe itself, any individual is unlikely to 'sell' the idea of participating in a technology probe study. Participatory design was mentioned earlier as a strategy to increase the input of the population into the design of a system. Given our experiences with the cardiac rehabilitation pilot-study, we also advocate participatory research design with collaborators on the ground.

5.4 Analytic Orientation

As was mentioned in Section 5.1, our analytic orientation leans towards symbolic interactionism. Blumer [39] offers three premises of symbolic interactionism:

- Human beings act towards things in the basis of the meanings that the things have for them
- The meaning of such things is derived from, or arises out of, the social interaction that one has with one's fellows
- Meanings are handled in, and modified through, an interpretive process used by the person dealing with the things he or she encounters

The importance of interaction on the establishment of meaning resonates with the focus of ethnomethodology. However, unlike the explicative output of ethnomethodologically-informed ethnography, where efforts are paid to keep abstraction and interpretation to a minimum in favour of producing rich descriptive texts [215], work informed by symbolic interactionism, such as Grounded Theory [107], purposefully seeks to draw out abstractions and conceptualisations to explain the findings.

The development of the grounded theory approach was motivated by a concerned with the traditional sociological hypothetico-deductive model in which data is forced to 'fit' pre-organised categories which prevented researchers from refining and developing theory further [216]. Instead, techniques of abstraction and conceptualisation are used to develop theory that is grounded in the data.

> *However, the 'grounded theory' approach in many ways shared the basic convictions of the natural science approach in that the eventual aim was to develop formal deductive theory, theory constituted out of interrelated variables [216].*

Grounded theory is an accepted methodological approach in HCI. For example, [116, 162, 203] are studies that have been referenced elsewhere in this thesis that have applied grounded theory, or use the techniques advocated by grounded theory but stop short at developing theory. The purpose of developing theory is to explain or predict a phenomenon [230]. The aim of this work was not to explain or predict, but rather to gain a nuanced understanding of the everyday practice and experience of health-related behavioural change. Therefore, we chose not to go as far as developing theory, but used the techniques to assist in the analytic process. The emergent themes from each of the studies are brought together and discussed in Chapter 9.

5.4.1 Data Collection and Analysis

All interviews were audio recorded and transcribed. As was mentioned earlier, we employed inductive analytic methods advocated by Lofland and Lofland [156] and Strauss and Corbin [230]. Transcripts were initially subjected to open coding, whereby each sentence was analysed in a process of sensitisation. The emergent codes were then subject to more focused coding, whereby similar codes were grouped together to form categories of phenomena. Similarities and differences were compared and contrasted, and the data was repeatedly revisited. Themes emerged that were then used to structure the data presented in this thesis.

The author did use try using the N-Vivo software package to organise the data and assist in the coding stage. For the most part she found it of limited use. Perhaps reflecting a preference for visual and spatial thinking, she preferred to write codes on paper copies of the transcripts and then write each code on a post it note, that could then be manipulated and rearranged. Writing was also an important analytic tool for the author, and it was often through the process of writing that further questions would arise that would prompt another pass through the data.

Each study was analysed separately, but the findings of each study caused the author to return to the findings of the others and revisit a particular topic that had not necessarily been the subject of focussed coding in earlier passes. Reflecting the characteristics of the

study domains, the findings of each study highlighted particular aspects of social practices of everyday behavioural change that caused us to expand our focus. As will be seen in Chapter 6.6, Weight Management proved to be a highly collaborative activity, offering much insight into particular forms of peer-involvement and individuals' strategies for harnessing social support while maintaining their privacy. In contrast, collaboration was virtually non-existent within the Families at Risk. In addition to issues of trust and isolation within the community (Chapter 7.8), very few participants were equipped to make the changes that they wanted to (Chapter 7.7), further reducing opportunities for collaboration. The inability to implement change was unique to the Families at Risk study, and so we revisited the Weight Management data to explore the topic of implementation. The Cardiac Rehabilitation study was the final study to be analysed. In addition to collaboration and implementation, the issue of motivation emerged as a topic of relevance; in particular with respect to the competing values inherent in everyday life that were involved in determining the degree of behavioural change (8.6). Again, the data from the previous studies were revisited.

5.5 Interpretive Framework

As was stated at the beginning of this chapter, we were initially interested in understanding the social practices of people engaging in everyday behavioural change. Through the process of inductive analysis described in the previous section, motivation and implementation emerged as additional topics of consideration. The framework recognises the pervasive nature of peer-involvement (collaboration) and the reciprocal influence that collaboration, motivation, and implementation have on each other. However, although influenced by peer involvement, the motivation and implementation of everyday behavioural change is also a matter of personal values and choice.

We struggled with the somewhat artificial nature of the distinction between the three topics, and are aware that this is one of many possible ways of organising and interpreting the data. We are aware that the distinction in the framework between motivation and implementation is reminiscent of the old mind/body, thinking/doing dichotomy. However, while the motivation behind behavioural change is primarily cognitive, it is influenced by matters of the body (physicality and physiological symptoms) and by matters of a social nature (external motivations and resources for change). Implementation is also not a straightforward matter of making changes, the decision of what changes to make and how

to go about making those change relies on an awareness of possible strategies, is influenced by the social norms and values associated with particular strategies, and the original motivation to change.

Despite the limitations mentioned above, the framework helped us to make sense of the data and provides a structure to the analysis that we hope will aid the readers understanding. The body of each study is structured around the three topics: motivation, implementation and collaboration.

5.6 Conclusion

In response to the need put forward in Part I of this thesis, to understand everyday behavioural change from the perspective of the individual, this chapter presented an argument for semi-structured interviews as a suitable investigative methodology. The chapter argued that the overall role of qualitative enquiry within this thesis was to provide a new lens through which to view the assumptions and values embodied in work emerging from this field.

On a more practical note, the chapter identified the inductive analytic orientation from which the data was approached. It introduced the domains that are the location of the core studies in this thesis and explained the decisions behind choosing those particular domains. The practicalities of gaining access and carrying out the studies were discussed, and the merits and limitations of the methods employed were presented. Finally, the interpretive framework was presented that will be used to structure the findings of the studies in the following chapters.

6 Weight Management

The fairly consistent citing of overweight and obesity as motivating factors for much of the emerging work in HCI and related domains [61, 62, 72, 74, 103, 153, 157, 237], and the fairly consistent omission of overweight or obese participants in the design or evaluation of subsequent systems, led to the decision to investigate weight management.

6.1 Introduction

Driven particularly by the social stigma that surrounds the overweight and obese, we were curious to find out if and how people who are trying to lose weight harness the support of their surrounding peer groups. As with the other studies presented in this thesis, we sought to explore the social dynamics of everyday behavioural change with a view to better understand the opportunities and constraints for socially focussed everyday behavioural change technology for use within this domain.

For details of the methodological approach employed throughout this study, please refer to Chapter 5. The remainder of this chapter reads as follows. Section 6.2 presents an overview of the existing literature surrounding the role of social support in weight management and current technological interventions. In Section 6.3 we provide an overview of the study participants: age, gender, marital and weight management status, and

current use of technology. As was explained in Chapter 5, we have chosen to structure the findings of each of the studies around three topics: motivation, implementation and collaboration.

6.2 Background

Social support has long been a component of weight management programs, be it within the relationship between health care professional and patient, or within peer support groups. It is considered an intrinsic component of a multifaceted strategy to facilitate weight management [92, 252]:

> *Weight maintenance requires lifelong behavioural change combining moderate exercise, lower fat intake, increased fruit and vegetable consumption, as well as social support. [77]*

Unfortunately, isolating the weight management-critical components within studies and programs is made difficult by the ambiguous and multidimensional nature of the term 'social support'; as Verheijden et al. [246] observed "social support was clearly defined on a practical level in hardly any studies". One exception to that observation was the study performed by Gorin et al. [111] that examined the effect of involving support partners in obesity treatment. Obese patients were asked to invite up to three partners to participate in their weight-loss program with them. Successful weight-loss (at 6, 12, and 18 months) was not found to correlate to the number of involved partners, but with the number of successful partners (weight loss >or= 10% at 6 months); those having at least one successful partner losing significantly more weight than those with no successful partners and those without partners. The authors conclude that: "support partners appear only to be beneficial in obesity treatment when partners themselves lose weight".

The forms of social support identified in peer-based interventions that were reviewed by Verheijden at al. [249] are listed in Table 6-1 overleaf. In the table, those entries with an asterisk indicate negative or neutral findings. As was mentioned in Chapter 2, study design prevented conclusive evaluation of the effectiveness of social support.

Further illustrating the complexity of the problem space, it has been shown that the need [246] and effectiveness [169] of social support varies depending on condition and characteristics of the individuals involved. For example McLean et al. [169] found that

while adolescents benefit greatest when treated alone, parental involvement was associated with weight loss in children, as was spousal involvement in adults.

Social Support Mechanism	Results
Husband Involvement	Control group lost weight at slower rate
Commitment Contract witnessed by peers	Control group lost weight at slower rate
Spousal attendance and couples contract	Spousal attendance led to largest weight loss
Group-based rewards	Greater weight loss for group rewards condition than individual condition
Peer-based self-help groups	Greater weight loss maintenance than individual condition
Peer-group*	Less weight-maintenance in peer-group than in condition with therapist contact
Social influence programme	More effective than behaviour therapy alone, as effective as therapist condition
Group meeting and peer problem-solving*	As effective as control conditions
Recruitment with peers	Most weight loss in those recruited with peers
Weight Watchers and monthly group meeting*	Less successful than weight watchers and individual counselling but more successful than weight watchers alone.

Table 6-1: Verheijden's Summary of Social Support Mechanisms in Weight Management Interventions

In a systematic review of commercial weight loss programs in the US that include a social component (online or offline) [239], minimal evidence was found to support the effectiveness of commercial online weight loss programmes. Meanwhile, within the medical community, efforts are being made to establish the validity of technology-facilitated weight management interventions. Findings so far suggest that the comparability of online and offline support may depend upon the stage of weight management. During the initial weight-loss period, a web resource with online chats [172] and an Interactive TV weight loss program [121] can be as effective as face-to-face equivalents. However, face-to-face groups were found to be more effective than Internet groups during weight-maintenance [254]. While increased access to information is a great benefit of the Internet, information provision alone does not guarantee behavioural change [85]. Independent studies into online and offline behavioural change programs have found that those that augment information with behavioural therapy (teaching behavioural strategies such as self-monitoring, goal setting, and social support) are most effective [87, 235].

The majority of literature surrounds online weight management programs rather than communities per se. Online health communities "provide a means for patients and their

families to learn about an illness, seek and offer support, and connect with others in similar circumstances" [185]. There have been relatively few studies of online communities for the overweight and obese. One such study compared the information seeking practices in an online health community with an Ask the Expert website [222]. While clinical and statistical questions were found in both, emotive (e.g. seeking supportive friends) and deviant (e.g. how to acquire prescription drugs without a prescription) questions only appeared in the online community. Depending on the viewpoint being taken, this relative freedom to explore options not readily available within the traditional medical domain is seen as empowering, or dangerous. The notion of expert patients, those who can manage their own conditions by developing knowledge relevant to maintaining health and countering illness [217], is being championed by UK health policy [81]. The subsequent 'need' to moderate content and opinion so that it lies within the conventional boundaries of medical advice is seen as a great challenge of online communities [185]. However, in an investigation into whether or not expert-patients challenge or adopt conventional thought relating to weight, body image, and weight management, Fox et al. [99] found that:

> *Engagement with the forum supported participant's self-management of their weight and in this sense, becoming an 'expert patient' appeared as a radical, democratising process, giving the patient control over their options. However, by using Xenical to 'treat' weight-gain and 'normalise' the body, the users were—intentionally or unintentionally—accepting and perpetuating a conservative and constraining biomedical perspective that a 'faulty body' could be 'treated'.*

Similarly, Hwang et al [131] found that in a cross-sectional study of 18 weight-loss forums, the presence of erroneous and potentially harmful advice was relatively low (8.6% and 6.6 % of total advice respectively). Furthermore, other members of the community subsequently corrected 34% of the erroneous advice and 28% of the potentially harmful advice.

6.2.1 Summary

This section has provided a brief overview of the existing literature surrounding social support and weight management. The bulk of literature is concerned with the effectiveness of integrating peer-involvement into the delivery of clinical weight management programmes. Various methods have been identified, and social support interventions appear promising, but their effectiveness is yet to be conclusively proven. The findings that the need for formal peer-involvement is dependent on the age of the individual point to a

need for tailored interventions and also sensitises us to the fact that facilitating social support may not make a positive contribution in all cases. This may seem to contradict the more general understanding that social support is positively correlated with health and health-related behavioural change, but actually only refers to the direct involvement of peers within an individual's behavioural change programme. This hints at a distinction between formal involvement and the everyday nature of supportive relationships, a distinction that was evident in the findings of our cardiac rehabilitation study (Chapter 6).

The contextually dependent nature of support was also evident in the literature surrounding online provision of social support in weight management programmes. Various studies have indicated a correlation between an individual's stage of change (weight loss or weight maintenance), and the effectiveness of on- or offline support. The findings that online programmes that employ multiple behavioural change techniques are more effective than those that provide information alone, echo the findings of the similar studies of offline dietary interventions that were discussed in Chapter 2. Together these studies indicate the importance of variety in supporting weight management, both in the form of media used and the behavioural change techniques employed.

There is relatively little research surrounding online communities that are not affiliated or integrated into a weight management programme, but the research there is raises the interesting issue of deviance. The concern that online communities need to be moderated does not appear to be strongly supported by the literature, but perhaps more importantly for this thesis, is evidence of the assumed authority of 'the establishment'.

6.3 Participants

We recruited eleven women and eight men to participate in the study. All but two were currently engaging in weight management activities: that is, they were either trying to lose weight or maintain their current weight loss. The participant group included two married couples; in both cases the husband and wife were interviewed separately. The participants represented a fairly diverse demographic: aged between 21 and 74 with occupations including nursing assistant, policeman, telesales operator, and computer technician. Three participants were students, and two were retired (one through ill-health). The retired participants were the two individuals not currently engaging in weight management and both were obese. Two of the other participants chose not to disclose their current or

previous weight. Therefore, in the following description of the group's pre- and current weight the participants just mentioned are not included.

Prior to weight management efforts eight participants were obese, three were overweight, and five were normal—as defined by their body mass index (BMI). At the time of the interviews, four were still obese, eight were now overweight, and six were normal. Of the six normal interviewees, only two were happy with their current weight. The remaining four were actively trying to lose weight. This raises some interesting questions: how do we judge whether behavioural change is positive or negative? Is weight induced behavioural change only positive if the individual is outside their normal BMI range? Is weight, rather than health induced behavioural change, ever positive? For the purpose of this chapter no judgment of positive or negative change will be made, other than those expressed by the participants.

An overview of the participants' ages, statuses, and strategies is provided below in Figure 6-1. An arrow indicates the participant's progress. The number in white is his or her participant's ID number that will be used in the remainder of this Chapter. Strategies are indicated by the colour of the arrow: dietary intake (red), physical activity (blue) or both (purple). Grey squares indicate that he or she is not currently engaged in any weight management efforts. The triangles placed outside of the graph represents those participants who chose not to disclose their BMI. Perhaps somewhat self-explanatorily, the gender of each participant is indicated by an M or F above his or her avatar/glyph.

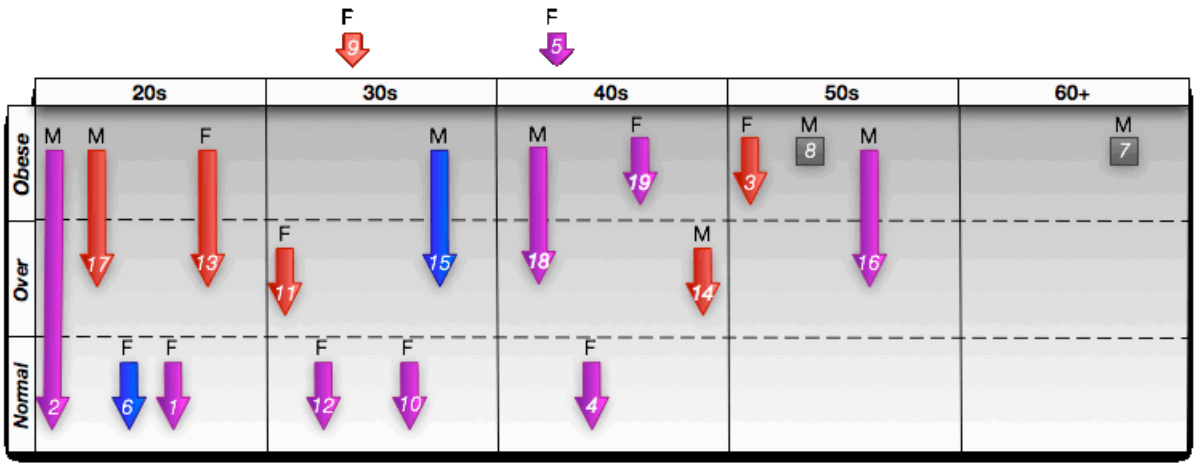


Figure 6-1: Weight Management Participants, Strategies and Progress

In order to manage their weight, the majority of participants employed a combination of dietary and physical activity strategies. Only five of the participants chose to focus on diet alone. Physical activity strategies ranged from going for walks, to doing aerobic or cardiovascular exercise at home, to going to the gym and participating in sports. Dietary strategies all involved restricting intake in some form or other, but ranged in severity from reducing portion sizes, to cutting out snacks, to following dietary programs, and in one case avoiding solid foods. A discussion of the strategies employed by the participants permeates this chapter, but is discussed in detail in Section 6.5.

6.3.1 Current Use of Technology

Apart from using scales to assess weight, the most common aspect of weight management with which participants used assistive tools was in the planning and self-monitoring of dietary intake. Far removed from the high-tech solutions featured in Chapter 3, the humble pen and paper were the method of choice for the majority of the participants. The form that the plan/record took would depend on which formal weight management program, if any, the participant was following. Some were given diaries with daily check boxes representing each of the food groups; others were given A4 templates with allocated space for planning and monitoring. Those who were not currently following a formal weight-loss program but had previous experience with such programmes chose to continue planning rather than monitoring, and appropriated whichever format they preferred to suit their own needs. Those who used diaries carried them around with them in their bag, whereas the A4 pieces of paper were placed in bags (n=1), in the living room (n=1), and stuck on kitchen cupboards (n=2). The two participants who placed the plans in open view in the kitchen were only planning rather than monitoring intake, which suggests that self-monitoring tools may require a more private space.

In order to be able to plan or monitor dietary intake to the degree that formal weight management programmes require, calculation is often necessary. In addition to paper and pencils, weighing scales, calculators and in one case, spreadsheets, were also used by the participants. For others counting calories had become second nature and no additional instruments were required. Given the tendency of the male participants to restrict quantity rather than content, it is unsurprising that it was mainly the female participants who planned/monitored in this way. The two male participants who did at one point follow a formal program's diet along with their partner (but did not join) reported counting points but not keeping a written record in the same manner as their partner.

Physiological self-monitoring during exercise was only reported by one of the participants. P15 used a heart rate monitor in an investigatory manner during his workout, he stated "looking at how hard I am working as opposed to how hard I think I am working, is quite interesting", and after his workout:

> *I have a very nice spreadsheet, which, every time I have finished the exercise I weigh myself and I [laughing], it is so embarrassing, then I go and sit in the changing room for 2 minutes and then I take my heart rate at the end of the two minutes and I record that. Every time, because I want to see if there are any correlations between weight loss and how fast I am recovering.*

Other participants would monitor their progress mentally, comparing their performance with others (e.g. during a game of football) or their own previous performances (e.g. how long it took them to run four kilometres on a treadmill).

The Internet was only used by three of the participants for exercise (P16) and diet related information (P18, P19). P19 was a member of a formal weight loss program and her husband followed the diet with her. When joining that weight loss program the individual was given an account with an associated website. As well as entering her weekly weigh-in results to generate a graph of her progress, she would use the forum to get recipe ideas and to read about other peoples' experiences:

> *These people that have gone on and lost maybe… 2 or 3 stone, or maybe more. It is just quite interesting, they are telling you, some of them, how it has changed their lives and things like that. It is quite interesting to read. It encourages you to see that it can be done.*

Her husband, P18, also used a Diabetes Forum in a similar manner. Both were "lurkers" [196], neither P19 nor her husband contributed to the online resource, choosing instead just to read. While P18 said that writing on a forum was not his "thing", P19 speculated that she might contribute when she had lost some more weight; suggesting that some may feel that they must earn the right to contribute.

There was only one report of weight management related computer mediated social support between existing peers. P6 discussed the sometimes confessional and sometimes motivational emails that she would share with one of her best friends who lived in a different city. Notice how the comparability of the peer, as well as their relationship, has an impact on the P6's reaction to the emails:

> *I got an email from her yesterday and it was like 'Oh I feel so unhealthy, I feel like I have eaten chocolate all weekend." You know that kind of thing… I mean she'll say that and I'll respond and say 'Oh I had a Chinese at the weekend' and I'll share what I've done bad with her. Or in fact it's the same if she has been really good, and she says "Oh I've been swimming today and I've had a healthy dinner" and I'll respond and say "Oh I've been bad and I've had this…". And it will make me feel a little bit guilty, the fact that… I kindof see her as my best friend and the same as me… so I think "Oh no, Penny has been good so maybe I should"… and maybe it will prompt me to go on the cross trainer.*

6.4 Motivation

An individual does not become overweight or obese overnight, and fleeting moments of awareness or even long-term concern do not necessarily prompt weight loss attempts. As Section 6.4.1 highlights, an individual's awareness of his or her weight is mostly related to the associated physicality and its deviation from an ideal, as perceived by the individual and influenced by societal norms. In this sense it was rare that health concerns would increase an individual's awareness of his or her weight, although a raised awareness of weight's impact on health often came in hindsight, when participants started to make some progress at weight loss.

When considering motivations behind weight management, it is easy to presume that an individual is either motivated by appearance or by health. Of appearance and health, appearance was found to be a much greater motivation than health. But through discussions with the participants, it became clear that this is somewhat of a false dichotomy. Appearance-based weight loss often caused the individual to feel health-related benefits that then spurred on continual efforts, with others also appreciating the health-related benefits associated with weight loss—even if it was not the overriding factor.

People are motivated to change by one of three broad categories of catalysts to change: age, upcoming occasions, and experienced events. In very few cases do individuals have a target weight towards which they are aiming; they have much more ambiguous goals ranging from how they look or feel, to maintaining a particular behaviour, to how well they perform at a particular activity.

6.4.1 Why Change Now?

Given the often-chronic nature of health-related behaviours that contribute to an individual's weight, it is interesting to consider what acted as the catalyst for change while

bearing in mind the aforementioned tension between appearance and health. What prompted them to change at that particular time?

We found that catalysts were based around occasions, events, or the aging process. Event-based catalysts were the most complex and were further categorised as physiological, situational, and psychological. The physiological catalysts were broken down into three further sub-categories. Definitions and examples for each of the categories are provided in Figure 6-2.

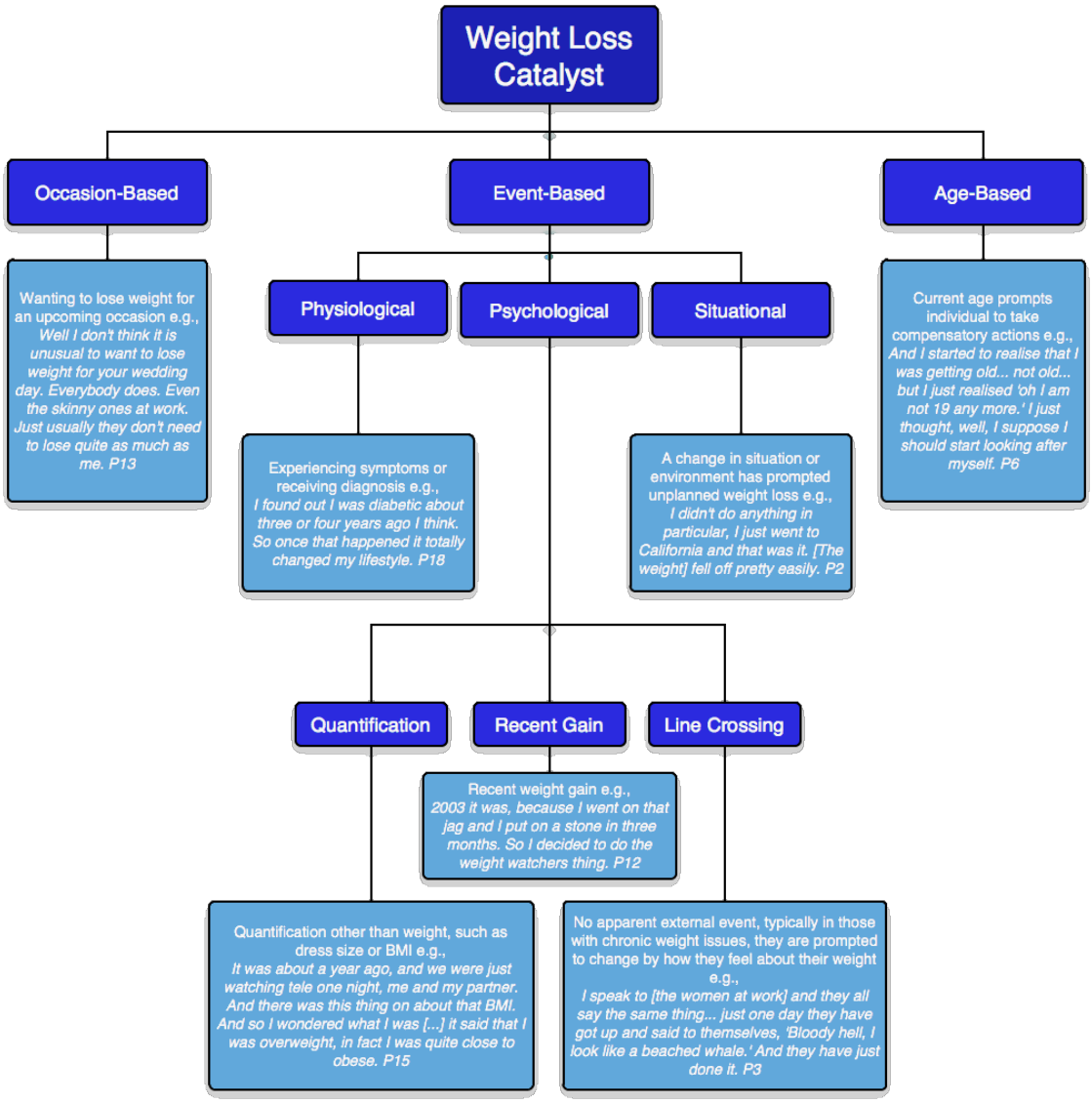


Figure 6-2: Weight Loss Catalysts

In a manner comparable to the compensatory and preventative motivations found during the motivational issues survey documented in Chapter 4, a few of the participants saw their current weight management efforts as a necessary strategy to deal with aging. For those

responding to aged-based catalysts weight was not so much a target, but an indicator of how well the body was being looked after. Weight served as an easy way to determine how much effort to invest in their dietary or exercise regimes.

Upcoming occasions were identified as a reason to try and lose weight by 55% of our female participants (in comparison to 0% of male participants). Example occasions included weddings, Christmas and other holidays. One participant inferred that slimming down for an occasion was a regular occurrence. Another identified four female members of her family who were trying to lose weight in the run up to a wedding. P13 was following the Cambridge Diet and had lost several stones in preparation for her upcoming wedding, but was quite open about that fact that she had no intention to maintain the weight lost. In fact she said that she could not wait until the wedding day and she could return to her old habits. In the cases observed during this study, weight management efforts that were prompted by occasion-based catalysts were motivated by appearance rather than health. Additionally, unlike any of the other catalysts, their position in the proximate future implicitly allocated a finite timescale to efforts.

In contrast, event-based catalysts serve as a starting point for weight-loss efforts. Situational catalysts prompted opportunistic weight-loss. In the cases observed, both male participants moved house (P17 moving to university and P3 moving abroad). The change of lifestyle associated with their moves caused unintended weight loss. In both their cases they had been heavily overweight since childhood, and they reported drastic results both with respect to the way that they looked and the way that they felt; which they then sustained with conscious efforts.

Physiological catalysts took the form of ‘warning signs’ such as breathlessness and bodily aches, or in one case a clinical diagnosis. Warning signs tended not to have a massive impact on prompting behavioural change, but contributed to an increased appreciation of improved physical health once weight had been lost. As with putting on clothes that were too tight, they caused fleeting moments of raised awareness. In only one case did a participant suggest that his reduced ability to participate in everyday activities contributed to his decision to lose some weight:

> *I became more lethargic and was less able to do difficult jobs... simple things like mowing a hedge or trimming a hedge and mowing the grass. Simple things became more tiring, which was ridiculous.*

In contrast P7, who was retired and finding it increasingly difficult to move due to his recent weight gain, said that he would not consider losing weight unless:

> *I know I am heavy but I am not worried about it [...] I would need to get a warning about a heart attack or something [...] The doctor has obviously said 'why don't you try...'. Ach I am trying nothing... nah.*

Unlike P7, who illustrated that medical diagnosis does not guarantee behavioural change, when P18 was told he was diabetic and that losing weight would help in the management of his condition, he set about changing many aspects of his lifestyle. Unlike any of the other study participants, P18 received formal support in making changes to his dietary and exercise regime. He received a consultation with a dietician who gave him a diet plan to follow, and put on an exercise referral scheme[15]. While the diagnosis served as a catalyst, the practical support facilitated the changes he wanted to make. Like P3 and P17, the physical benefits that he felt as a consequence of his weight loss served as a motivation to continue his efforts.

The final sub-group of event-based catalysts are psychological; that is, an individual's reaction to the perceived implications of their weight. The most discrete of the psychological events involves the quantification of weight such that the numeric value itself (e.g. BMI, dress size) is deemed unacceptable by the individual and prompts remediative action. Similarly those who had experienced weight gain, over a relatively recent time period or over a period of many years, sought to correct the situation. In these cases the catalyst was difficult to define, for the recent-gain, the weight-gain in itself prompted action. For those who had steadily gained weight over several years, it is the sense that they have crossed the line beyond what they deem acceptable for themselves.

6.4.2 Measures of Success

Reflecting the variety of catalysts behind the participants' decisions to engage in weight management, there were also numerous goals besides, and often instead of, a desired amount of weight loss. In fact, apart from the bride-to-be who just wanted to lose as much

[15] A Glasgow-based exercise referral scheme whereby individuals are referred onto the scheme by their GP, Practice Nurse, Physiotherapist or Cardiac Physiotherapist and are invited for an exercise consultation with an exercise counsellor at their local leisure centre. The individual receives individual advice and support form the exercise counsellor to help them become regularly physically active, alongside subsidised access to local council run leisure facilities.

weight as she possibly could before the wedding (P13), target weights only accounted for 26% of weight management goals. Of the five participants who were aiming for a target weight, two of those were aiming for incremental goals. P19 did so as instructed by the formal weight loss program she was following, but P3 chose to do it because of previous experiences of aiming for seemingly out of reach targets:

> *Now when somebody is this size, 18 stone 2, and your target is 9 ½ stone… now that is a mountain away isn't it? It feels like a mountain away… 'oh I am never going to get to that'. So my goal was to get to 17 stone, and now it is to get to 16 stone. I've done it this way. I've done it that way, I've done it the next way, lets try it like this, just go for it. A little bit at a time and see what happens.*

Three of our male participants who had initially been obese and were now overweight (P17, P18) or normal (P2) all said that they were happy with their weights but would consider losing a few more pounds "a bonus". Desired weight-loss was often considered in relation to how the individual would look at that weight, or as a secondary concern to the desire to simply feel comfortable wearing particular clothes:

> *But I would definitely like to try and lose some weight, not a drastic amount, just enough so I feel a bit more comfortable. I've got short legs, so it is not easy to find something that can fit you in the length and around the waist. P5*

In addition to the two participants who were prompted to make changes as age-based compensatory strategies, the focus of the participants' efforts that were not losing weight for a specific occasion had shifted from weight-loss to lifestyle or fitness. P2 explained:

> *I'd say at the beginning a lot of the motivation was body image and then as I started to feel the benefits of it… I stressed my joints less being able to run and stuff and just sustain activity at the same level as all my other friends then the health thing kicked in and I was like, 'this is so much better'.*

For many, maintaining the healthy behaviours or change in lifestyle was a goal in itself. For others, as will be discussed in the following section, where the weight-loss strategy had involved sport, the sport itself had become the focus; weight-loss then being considered the means through which to improve fitness and performance at the sport.

6.4.3 Summary

It is clear from what has been described above that weight management efforts are driven by much more than just objective measures of appearance or weight. Even when

quantifiable measures of weight were the catalyst of weight management efforts they were mostly subjected to the individual's judgement of how much was too much. The goals of weight loss were similarly subjective, a target weight loss being considered, if at all, alongside how an individual looked or felt at that weight.

Weight, in this respect, holds multiple meanings other than the number of kilograms an individual weighs. It is an indication of age and stage of life. It is the labelling of an individual as obese, overweight, normal or underweight. The physicality of an individual has implications for the kinds of clothes that he or she can wear comfortably. The size of needed clothing seems to be of particular importance. The health benefit of being a normal weight barely registers, until hindsight affords appreciation.

Of course, despite the insistence of the participants that they determine what they feel to be an appropriate weight or shape, it is artificial to separate how an individual feels psychologically about the way they look from the societal norms that subsequently guide any feelings of deviance from what is acceptable or attractive [9, 40, 181, 229]. The historical emphasis of the importance of appearance for women in western society is still evident in the predominantly female phenomenon of occasion-based weight management.

6.5 Implementation

To recap, in order to manage their weights, the majority of participants employed a combination of dietary intake and physical activity strategies. Only five of the participants chose to focus on diet alone. Physical activity strategies included going for walks, doing aerobic or cardiovascular exercise at home, going to the gym and participating in sports. Dietary intake strategies all involved restricting intake in some form or other, such as reducing portion sizes, cutting out snacks, following dietary programs and in one case avoiding solid foods.

6.5.1 Physical Activity: An End in Itself?

Some of the reasons given for not including exercise in weight management efforts were: not liking exercise (P13, P17), lack of time (P9), and a disbelief that exercise could contribute (P3). P3 worked long hours doing a physically demanding job and explained:

> *[Son] will say, 'oh you need to exercise more' and I say '[Son], I work in a 25 bedded unit that's a really busy ward' [...] I feel personally, I mean I think*

> *exercising is great but, [...] it is a great pass time and all the rest of it. But it doesn't keep you thin.*

Unlike the participants of the studies discussed in Chapter 4, nobody talked about actively seeking to increase their everyday activity levels (although P17 speculated that making such changes to his daily routine would be a future goal to focus on). Instead, those who did participate in physical activity as part of their weight management efforts preferred to participate in purposeful exercise sessions: mostly in the gym (n=5), by going for weekly walks (n=4), by participating in sports (n=3), or by doing aerobic exercise at home (n=2).

While a similar percentage of each gender chose exercise as a strategy to manage their weight (64% of females compared to 71% of males), when speaking to the men about the exercise that they had adopted it became clear that what had started as a means to an end, had actually become the end in itself. After a year of cycling to lose weight, P16's motivation to manage his weight was in order to improve his cycling performance:

> *If I have not been on the bike for a while or if I feel that I have put a bit of weight on and get back on the bike I can tell… you know, that I am not maybe going as well as I could, as fast as I went before, or going up hills, and I start to struggle a wee bit.*

This reversal of motivating factors was also apparent with P18, who was given free gym membership by his GP to lose weight, and whose focus now was to remain fit enough to continue participation in the circuits class he attended, and to run the yearly 10k race. P2 cited retaining the ability to keep up with or outrun the friends whom he played sport with as continuing motivation to maintain his current behavioural change, but alongside P17 he also took a more holistic standpoint, speculating about further improvements to his lifestyle rather than weight management efforts. One of the female participants (P10) described going to the gym as a hobby, and in this sense was the most similar to the male participants described above. The only female participant to take part in a team sport had played netball once a week for many years (P12). For her, the main benefit of playing the team sport was the sense of responsibility to the rest of the team that ensured that she would turn up, but her primary goal remained weight management.

6.5.2 To Diet or not to Diet: A Matter of Control?

Interestingly, many participants chose not to describe their dietary strategies as diets. Non-diet strategies, what they described as "common-sense", involved reducing portion sizes,

cutting out snacks, or healthy eating—each of which falls under the Oxford Dictionary's definition of a diet: 'a restricted regime of eating, followed in order to lose weight or for medical reasons'[16]. Those who avoided an affiliation with dieting rejected what they considered to be excessive control over dietary intake for various reasons including having known someone who was anorexic or the fact that they perceived self-monitoring to be a draconian practice.

P11 was one of three participants who were members of weight-loss organisations, all of whom appreciated the discipline that was introduced along with the dietary programmes. P13, who was following the most extreme of the programmes[17], liked that the choice of what and whether to eat had been taken away from her. Somewhat similarly, although as part of a less drastic program, P11 liked the fact that by creating a food plan she would no longer need to think about food or what to eat during the day.

Although only three participants were members of weight-loss organisations at the time of the interviews, five others were using their knowledge of weight-loss programmes to devise their own dietary strategies. Knowledge of the programmes came from their own experiences or the experiences of friends and family members. In some cases they formed informal diet clubs themselves, replicating the weekly routine of weigh-ins (further discussed in Section 6.6.4), but mostly they mixed and matched aspects of multiple programs so that it would suit their preferences.

Meal planning was an often-employed strategy by the mix and matchers. P12 was one of the participants who planned her meals in advance in accordance with a weight-loss organisation of which her sister used to be a member. In contrast to the all-or-nothing approach favoured by those who liked the discipline of following a dietary program, P12 would stick to the plan throughout the week but take each weekend off.

Evidence of the flexibility and negotiation of strategies was also found elsewhere. P18 followed the same diet that his wife (P19) followed without becoming a member of the weight-loss organisation. P15 initially did the same, but then stopped the diet when his weight-loss plateaued, in favour of continuing efforts through exercise.

[16] www.askoxford.com
[17] P13 was following the Cambridge Diet, a rapid weight loss low calorie diet (~400cal/day) with nutritional supplements. She was on the 'no solids' version of the diet.

6.5.3 Summary

Patterns have again emerged as they did in the previous section, that support existing gender-biases towards physical activity and dieting: females are far less likely to engage in team sports [120] and men are more likely to reject the notion of dieting [112].

The perspective that physical activity is something that a certain type of person does recurs throughout this thesis. Unlike eating, it is something that must be introduced into an individual's daily routine. The need to find time to participate in a physical activity, and the need to find a physical activity that is enjoyable, both present significant challenges to those who are not naturally (or socially) drawn to participating in physical activity. The question of why some people are so averse to physical activity is worthy of further investigation. Is it that people equate physical activity to sport, and sport to the athletic physiques that pervade mass media? Is it just that some people have not been exposed to the type of physical activity that they would enjoy? When an individual finds a physical activity, typically group-based, that he or she enjoys then it appears that the activity itself becomes the motivation to continue and perhaps becomes more sustainable than an activity carried out for the reasons of weight management alone. The belief that physical activity is not effective, another recurring theme, is perhaps a more pressing barrier to participation.

In contrast to the demands of introducing new activities into daily routines, dietary approaches to weight management focus on restricting existing behaviours. We observed three approaches to dietary strategies that reflect different attitudes towards who determines what the individual should eat and the degree to which dietary intake will be regulated:

- prescriptive dieting: control is given to the weight loss organisation, which determines dietary intake
- flexi-dieting: the individual determines what aspects of various prescriptive diets to adhere to, or the degree to which he or she will follow them
- sensible eating: the individual rejects traditional notions of dieting and chooses to make common sense changes which primarily affects the quantity of dietary intake rather than content

6.6 Collaboration

Although weight is considered by many to be an intensely private issue, we found weight management to be an inherently social activity. In addition to the broadly accepted 'societal' influences on perceptions of weight, a peer group (spouses, relatives, friends, and colleagues) constructs social norms and a frame of reference through which weight management efforts are motivated, driven, and evaluated. Peer-involvement is not limited to engagement in the execution of an individual's weight management plans. They may not necessarily be aware of their involvement, nor does peer-involvement always result in a positive contribution. We observed six broad forms of peer-involvement: inductive, obstructive, passive, supportive, proactive, and co-operative. The phrases in Table 6-2 serve to crudely illustrate the concept of the various forms of peer involvement.

Peer-Involvement	**Illustrative Phrase**
Obstructive	*"Don't do it."*
Inductive	*"You should do it."*
Proactive	*"Do it with me."*
Supportive	*"I'll do it too."*
Cooperative	*"Let's do it together."*

Table 6-2: Forms of Active Peer Involvement in WM

Although none are as simple as the above phrases (as will be discussed shortly), passive involvement is too complex to convey in such a manner. Despite the apparent misnomer, we suggest that passive involvement is the most influential. There are a variety of ways in which peers' passive involvement contributes to:

- an individual's attitudes towards his or her weight and desire to lose or maintain their current weight
    - are peers in same situation?
    - what are peers' attitudes towards weight?
- an individual's awareness and preference for particular weight loss strategies
    - has any peer lost weight before?
    - how did he/she do it?
    - what strategies are socially acceptable?
        - diet v. sensible eating

        - exercise v. sport v. everyday activity

    - are any peers currently engaging in the above strategies?

The various forms of peer-involvement are described and discussed in more detail in the following five sections.

6.6.1 Not Really Alone: Peer Involvement in Solitary Weight Management

Only three of the participants tried to lose weight alone, and all of these were aged between 21 and 25. P1 was of normal weight according to her BMI but had gained 10kg over the past 18 months since moving to the UK. Of all of the interview participants she appeared to be the most secretive with regards to concerns about her weight. Despite dieting and going to the gym for two months to try and lose weight, she only ever mentioned her weight to her friends in the UK in a tongue-in-cheek fashion:

> *Sometimes, you know, like joking, you know, I say "oh no I am so fat", but not really talking about it as a problem. I think it's a problem but people don't think it's a problem. I do. I haven't told anyone. It's just sometimes I will joke "oh no I am so fat" and they will offer me chocolates and I will go "oh no, I am on a diet you know…" [laughs] But no I don't tell anyone.*

She appears to use humour to test the water, to establish responses without committing to exposing how she really feels. The responses from her UK friends so far have been affectionately dismissive, telling her that her figure is great and that she doesn't need to lose any weight. She appears equally dismissive of their responses, choosing to focus instead on the comments made by her family at home:

> *My family are always like 'hey girl watch your weight' and you know, 'watch what you are eating because the food is not the same… and even for your health, take care of yourself.'*

The remaining two participants who acted alone were also different from the other participants with respect to them having grown up overweight, both sharing similar stories. While P2 was overweight despite being an active youth, P17 became overweight during his early teens after an injury prevented him playing sport. Both P2 and P17 were obese prior to making behavioural changes, and acknowledged that overeating was their primary problem behaviour. Neither participant could identify any significant other that may have been involved in their weight-loss attempts. However, both participants experienced

situational changes that prompted their behavioural changes. P2 moved to California for a year and took the opportunity to adopt a more active outdoor lifestyle:

> *It was just a natural kind of... I dunno… I always said I was going to lose it and the time just arose, and I was like, 'right.'*

Similarly, P17 experienced unintentional weight loss when he went to university; then more recently had a change of job, which increased his daily activity levels that subsequently prompted further behavioural change. Both remembered their parents nagging them as teenagers, and themselves not being ready to listen. For these participants the steps needed to resolve their weight problems were obvious and relatively simple, and when they felt ready they were comfortable taking them alone.

Despite the fact that in the three examples described above each participant considered him- or herself to be acting independently, these examples introduce three forms of peer-involvement: inductive, obstructive and passive.

6.6.1.1 Inductive Involvement

The comment made by P1's family is an example of inductive involvement, whereby the comments are, or are perceived to be, intended to instigate change. Typically made by family members, they can easily be perceived as offensive, ranging from "you're putting on a bit of beef, are you not" (P11's brother), to "you are going to die young" (P3's parents). It is impossible to gauge how effective such comments are in prompting behavioural change. The comments made to P1 by her family certainly were central to her desire to lose weight, but for the most part such 'nagging' was nothing more than hurtful and were eventually dismissed. Although it is tempting to judge such comments by others as thoughtless and unethical, there is the argument that it is sometimes necessary to be cruel to be kind. The sensitivities associated with such involvement in an individual's weight management is illustrated by the following vignette taken from the focus group, whereby P11 has just mentioned that her brother told her that she had recently put weight on:

> *11-Actually my brother did say once, he only mentioned it once when I was starting to put on the weight…*
> *12- Did he?*
> *11- He did say once but only because he was so used to me not and he said something like "my god [name] you're putting on a bit of beef are you not", or something like that. Or something flippant like that.*

10- Do you know I don't think anybody has ever said anything like that to me. And I've been big, I was big before. I don't think anybody has ever…
12- See my gran would say, and my mum.
9- I would never ever.
10- See a good friend would, see if you were putting on a lot of weight, a good friend would say.
12- No, no way.
9- No I would never say that to somebody.
10- See I think a good friend would say something
12- I think you can figure it out for yourself, you don't need a friend to say "aye, you're fat"
9- Look at what (12) has just said, you don't want to make her feel like that.
12- You want your good friends there to support you when you figure out for yourself that you are putting weight on. You don't need somebody telling you. You know fine well when you are putting weight on.
11- But then when he said that it did make me think, "oh maybe he is right", do you not think that sometimes you need someone to…
12- No.

6.6.1.2 Obstructive Involvement

It may be that peers are in a no win situation, because dismissing an individual's concerns about their weight is almost uniformly regarded as unhelpful. Such reactions can be said to be an example of obstructive involvement, whereby peers do not support an individual's weight management efforts; often leading to the individual seeking alternative sources of support. It is similar to inductive involvement in the respect that the peer's intention may be well meaning. Husbands were the worst offenders when it comes to offering 'bad' foods as treats while their wife is trying to avoid such foods. Undoubtedly an expression of care, this was highlighted by five of the seven married women interviewed as the single worst thing that their husband does while they are trying to lose weight. Coming home with a Chinese meal and a bottle of wine would normally be welcomed with open arms, but is seen as unnecessary temptation when dieting. Husbands can find themselves frustrated when it comes to supporting their wives: while it is frowned upon to provide temptation, it is even worse to discourage their wife from eating 'something she shouldn't':

I would have a wee bowl of crisps, because crisps are my thing. And he would go like that 'erm, two days?' [without having crisps], but not because he thinks that you're getting fat, I never feel like that, but it is not helpful because it makes you think, 'What are you… the crisp police?'

Despite any well-meaning intentions, there seems to be a fine line between comments and actions being perceived as encouraging or being perceived as interfering. Interestingly,

there was no such tension for our married male participants whose wives were all actively involved, to varying degrees, in their weight management efforts (see Section 6.6.3).

6.6.1.3 Passive Involvement

The change in lifestyle associated with P3's move abroad and P17's move to university show how the social norms of a peer group can influence an individual's weight-related behaviours, prompting unintended or opportunistic weight-loss. In the cases we observed, both male participants moved house (P17 moving to university and P3 moving abroad). The change of lifestyle associated with their moves caused unintended weight loss. In both their cases they had been heavily overweight since childhood, and they reported drastic results both with respect to the way that they looked and the way that they felt; which they then sustained with conscious efforts. The sort of involvement that the peers had on their weight loss is an example of passive involvement, as they were not necessarily aware of their influence or involvement. Passive involvement is further described in the following section.

6.6.2 Passive Involvement as the Foundation of Behavioural Change

As was indicated at the beginning of this section, passive involvement has a broad scope of influence on the health-related behaviour and behavioural change of an individual. It sets the foundation for more active forms of involvement. In this section we consider the social shaping of behaviour and everyday talk as two forms of passive involvement, before considering the role of comparison and competition in such everyday talk.

6.6.2.1 Social Shaping of Behaviours

Life-events such as suffering an injury, going to university, moving abroad, getting married, having children, and getting old, all framed the stories that participants told about their weight. Apart from the physiological influences that such events have, what was evident in their stories was the influence that the social changes associated with each event had on the individual's health-related behaviours.

Humans are social beings, and they gravitate towards the activities that the people surrounding them participate in. The abrupt change of social environment experienced by P1, P3, and P17, serves to illustrate the impact that the behaviours of surrounding others

has. P6 also started going to the gym when she went to university because that is what her friends would do. Nobody explicitly invited her to participate, she just went along.

> *I just started because, to be perfectly honest because at school you just go through school and then you come here and all of a sudden your friends are like 'right I'm off to the gym' and so you think 'I could go to the gym'. There is nothing... before then I was a kid before that so you don't think about it. And then you see your friends and they are going to the gym, so I would meet people on a Saturday and go to the gym. It wasn't really a fitness thing at that age it was just something to do, something that your friends did, where you would go and meet people.*

Apart from gravitating towards the activities of others, people also develop patterns of behaviour together:

> *I think most of my weight went on, I would say, once we got married. You stop going out every night with your mates and playing football and things like that. You are married and then you are sitting in, watching TV, cups of tea, biscuits and things like that. P18*

Domestication also presents demands that influence the daily activities that an individual engages in. The day-to-day running of family life primarily affected the female participants' efforts to diet and exercise. Between working, doing the housework and looking after children, very little 'me time' was left for participants. By the time children were put to bed it was either too dark or too late to go for a walk, or participants were exhausted. Only one of the male participants, P15, identified family-related duties as a constraining factor. While most husbands supported their wives' weight loss attempts in theory, or became actively involved as described in Section 6.6.3, there was no evidence of them offering practical support by alleviating their wives' domestic chores so that the latter had time to exercise. However, it should be said that there was no evidence of any of the participants asking their husband to help in this way.

6.6.2.2 Speaking of Weight

Perhaps reflecting the current focus of the media in the UK—with the prevalence of Size 0 and Obesity in magazines and on the news, and social marketing campaigns driven by the Department of Health—weight and diet is an everyday topic of conversation for most participants.

> *There is this guy at my work and we always have lunch together, and he always gets macaroni cheese and chips. And today I was like 'You getting*

> *macaroni then?' and he was like 'Oh no no no... look at that fat belly.', so he had a baguette... You know it is just part of everyone's life isn't it? P6*

The workplace, in particular, was a frequent source of talk about weight for men and women. However, women were more likely to extend the discussion to also include female friends and family members. For men, if weight was discussed within the workplace, or within a circle of friends, it was more common that the discussion would take the form of friendly banter, gentle ribbing and light-hearted competition. The middle-aged participants reported such occurrences most frequently, possibly because this is a time when most of their friends and colleagues realise that they have gained weight over the years. Age was attributed by most participants (both male and female) as being a 'natural' cause of weight gain. P14, P15, P16 and P18 all talked about their weight creeping up on them almost without them noticing. Male colleagues would often make flippant jokes about middle-age spread, regardless of whether they themselves were middle-aged or overweight. Far from taking these comments to heart, our male participants seemed to relish in being able to return the name-calling favour when their weight-loss meant that they were no longer heavier than their friends and colleagues:

> *Well, up until I lost all that weight I was heavier than Frank, and he used to kid me on and say that I was fat and all that. So now I have turned it round on him, and kid him on about it.*

For the most part, such banter was not delivered in the hope of changing an individual's behaviour, it was just part of the humour and familiarity of a friendship. In other cases though, it masked a concern for the health of the person at the butt of the remark. After making radical changes to his lifestyle following a multiple diagnosis of diabetes, high cholesterol and high blood pressure at the age of 42, P18 discussed his subsequent raised consciousness of the healthy and unhealthy lifestyle choices that he and his friends were making. The only way that he has found to bring the subject up is through "winding them up":

> *They say I am a pain in the arse because I keep winding them up about what they are eating and what…. I can't help myself, I can't help it when I see… one of my pals who works with us, well he was backshift. He had a sausage supper for dinner, at that time in the work, he had a sausage supper at 11 o'clock at night. And I am thinking 'you are going to die' and I was kidding him on, you know just winding him up… [I said] 'You're going to die', in fact I said 'see when you die they are going to have to get one of those big American caskets to take you out in'. Aye, I wind him up. But aye, they all say that I am a pain in the arse now.*

Although such jokes and remarks are an accepted part of certain friendships, as with most forms of inductive involvement they remain largely ineffective as motivational tools for behavioural change, they also existed exclusively within male relationships.

It is not surprising to find that women were more aware of their weight than men. Historically, a woman is identified through her beauty rather than through her actions or achievements [40], and so the great importance that some women place on their weight is not entirely unexpected. Although trends in the media indicate that men are now also under pressure to be mindful of their weight, our male participants were not illustrative of this trend. Such a statement may seem at odds with the fact that 75% of the male participants were engaged in weight management at the time of being interviewed, but it should be noted that five out of the six who were engaging in weight management were obese when they started making behavioural change[18]. That is not to say that our male participants were unaware of their weight, they simply did not attribute as much meaning to the fact that they were overweight, as did the female participants.

Weight is a much more sensitive subject for women (as illustrated by the vignette at the end of Section 6.6.1.3), but at the same time it is treated as something easily manipulable. 55% of female participants cited upcoming occasions as a reason to try and lose weight (in comparison to 0% of male participants). Talk of upcoming occasions would often prompt efforts to lose weight. P13 was following the Cambridge Diet and had lost several stone in preparation for her upcoming wedding, but was quite open about the fact that she had no intention to maintain the weight lost. In fact, she said that she could not wait until the wedding day and she could return to her old habits. Hers is an extreme case, but other participants echoed it, P3 reflected:

> *You just go back to it... that's the worst bit. You just go back to your same way and you shouldn't do that, you should try to keep eating healthy.*

Sharing hints and tips was a major topic of the women's weight-related conversation. Although only three of the female participants were members of weight-loss organisations at the time of the interviews, five others were using their knowledge of weight-loss programs to devise their own dietary strategies.

[18] The two male participants not engaging in weight management at the time of interviewing were also both obese.

So, despite the sensitivities associated with weight, weight remained a frequent topic of conversation for women. Perhaps reflecting the underlying sensitivities, women's weight-related conversations were subject to comparability filtering not evident in the reported practices of men.

6.6.2.3 Relative Comparability

We found that women used the relative comparability of others to determine whether or not a participant disclosed particular aspects of their weight management:

> *I suppose if somebody got really, really heavy you wouldn't make a comment because they might be self-conscious about it. You know you would kinda, hold back I think. None of us have got to that stage where we are really heavy. P19*

Participants avoided the direct comparison of weight-loss with others "because we are all different shapes and sizes" (P4). However, successful weight losses always served as inspiration, regardless of similarity of size:

> *She was really quite hefty and she looks fabulous now, she really does look good on it. And I think well she has managed it and she was bigger than me, probably the same height but bigger than me, so for her to lose weight then it is possible. P5*

Although comparisons were mostly weight-based, the three eldest women all expressed concern about discussing their weight-loss with younger colleagues for fear of cultivating obsessive attitudes. As large weight-loss inspires regardless of similarity, the elder participants were uncomfortable when younger colleagues who only had a one or two pounds to lose approached them asking for advice.

6.6.2.4 From Comparison to Competition

Competition played a relatively small role in the weight management practices of the participants, but was more openly discussed by our male participants. In keeping with the findings during the trial of Shakra whereby the female participants used their peers' activity levels as a target to stay within range of rather than beat, P6 speculated that the motivation derived from her friend being active did not come out of competition:

> *Not competitiveness but I suppose... almost copying... maybe she has gone every night that week. I feel guilty but I don't feel that I want to do better than her.*

However, competition was openly fostered between some of our male participants. The manifestation of the competition varied, from trying to lose more weight to being better at whatever physical activity was being undertaken. P2 cited retaining the ability to keep up with or outrun the friends whom he played sport with as continuing motivation to maintain his current behavioural change. In the cases of P14 and P16, who attended the gym rather than take part in a sport or group activity, both expressed competitive tendencies with themselves, periodically pushing themselves to see how far their bodies could go.

6.6.2.5 Summary

Passive involvement goes some way to explain the construction of weight, weight management and health-related behaviours by a peer group. As indicated earlier, gender appears to influence attitudes and practices. One manifestation and simultaneous cause of gender-based differences is evident in the way members of each tended to talk about weight.

According to Festinger's social comparison theory [96], people evaluate their thoughts and actions by comparing them with those of others; preferring to do so with those whom they consider to be similar to themselves. The relative comparability of peers provided a source of implicit and explicit competition and motivation, and also served as a mechanism for determining much information they would disclose to others about their weight concerns and weight management efforts (an issue further discussed in Section 6.6.4). In accordance with Festinger's theory, participants avoided the direct comparison of weight-loss with others. However, successful weight loss always served as inspiration, regardless of similarity of size.

The workplace[19] has emerged as a common location for weight-related talk. It could be that the long hours people spend with their colleagues makes them suitable peers to discuss longstanding or everyday issues such as weight. There are more important things to discuss than weight when meeting friends who are only seen intermittently or infrequently. Similarly, the workplace presents an alternative venue for voicing concerns that an individual would rather not further impose on people at home.

[19] Or in the case of those who do not work, the peers who they spend time with during the day e.g., neighbours.

6.6.3 Taking the Lead and Toeing the Line in Proactive and Supportive Involvement

In contrast to the passive involvement described above in which behavioural change may not necessarily be explicitly considered, proactive and supportive involvement is focussed on initiating or supporting behavioural change. Unlike inductive involvement (see Section 6.6.1.1) whereby peers simply instruct an individual that change is required, peers encourage behavioural change by participating in the target behaviour and invite the individual to participate with them (proactive), or participating in the target behaviour in order to ease the burden of behavioural change (supportive).

6.6.3.1 Inviting Participation

Neither of the young male participants who had been overweight during their teens expressed regrets at not having someone to talk to about their problems, but retrospectively desired proactive 'others' who would have prompted and encouraged activity. Proactive others are those such as P15: when P15 had lost weight after dieting and taking up cycling, his brother's wife approached him and asked him to take his brother out cycling in order to help him lose some weight. P15 persisted in asking his brother to come cycling with him, never explicitly mentioning weight-loss, until he agreed to go with him. Although his brother initially refused for fear of not being able to keep up, his brother has since become a more avid cyclist than him, and has lost four stone in the process.

For our male participants the first point of meaningful weight-related conversational contact with others would, more often than not, be with regards to the actions that they intended on taking in order to resolve the problem, rather than the problem itself. Men seem to avoid the involvement of friends and colleagues in the reflective, decision-making period when an individual determines what course of action should be taken. P16 had been gaining weight over a number of years after a series of injuries prevented him from participating in sports and subsequently became inactive. He decided that he would start going to the gym, but instead of going alone, he encouraged his workmates to go along with him:

> *I thought 'well it is about time someone started this up'. So I decided the more the merrier, and I managed to convince them to come along… I just said 'Right I am going to start going, who is coming with me?', 'Why aren't you coming, right OK?', 'Lets do it, try it, and see what it is like'.*

This prompt from P16 to encourage his workmates to go to the gym, had not been preceded with a discussion about his or their weight, nor was weight a topic of conversation:

> *I think…. I suspect that… we… men… or at least the men I know consider [weight] to be a personal thing. There are just some things that you don't particularly discuss… it is understood. Some things you don't need to discuss, it is understood.*

This implicit understanding and communal action stands in contrast to the communal ritual and primarily individual action that was observed in the co-operative involvement of female friends, as will be discussed in Section 6.6.4. When asked why colleagues at work choose to trade dieting tips daily as opposed to become more active together, P5 responded "I don't know, I think it might just be that everyone has their own lives, you know?" This response highlights two areas for consideration: firstly, the demands of home life that appear to influence women's weight management efforts in a way not shared with the male participants, and secondly, while work is a place where ideas are discussed, it is at home that much of the work of weight management is carried out.

Proactive involvement was only evident in three of the thirteen couples who were represented by the participants of this study, but in each of those cases it was the male who was encouraging his partner to try an alternative approach to dieting that he was finding helpful (P16), start going on walks with him (P7's husband), or recurrently asking to start going along to the gym with him (P19's husband, P18). A lack of proactive involvement may be reflective of the fact that a partner may not participate in any suitable activity, but while participation in particular behaviours is a prerequisite for proactive involvement, it does not necessarily precede it. For example, while P15 had been instrumental in encouraging and persuading his overweight brother to start cycling with him, he chose not to persuade his spouse. Echoing the perception that exercise is something that certain types of people do that was observed in the Cardiac Rehabilitation and Families at Risk studies, his reason for not asking his spouse was, "I don't think exercise is really her thing at all".

6.6.3.2 Easing the Effort

More commonly than instigating change, both male and female spouses would seek to ease the effort of behavioural change by supporting and facilitating the changes that their partners were making. Unlike proactive involvement, supportive involvement was directed at dietary changes. The amount of effort invested by the spouse varied. In some cases, it

was a matter of eating or cooking the low-fat diet that the individual wanted to follow, and others went to the extent of planning their spouses' meals for the week or following the diet as well "to keep him on the straight and narrow" (P11). There were isolated incidents when friends or colleagues supported an individual's efforts in this way, such as when P19 went to a party after a night out and her friend purposely avoided offering her pizza. However, the collocation of spouses in the home make them more suited to supportive involvement, despite the tensions associated with spousal support described earlier.

6.6.3.3 Summary

The strength of proactive and supportive involvement is their practical orientation. Instead of focusing on the problem, they focus on efforts to resolve the problem; in this sense, they resonate with the resilience theories of behavioural change discussed in Chapter 2. The presence of proactive and supportive involvement is dependent on existing peers' participation in the target behaviour, sharing an interest in making behavioural changes themselves, or having an interest in supporting the individual's weight management efforts.

6.6.4 Selective and Incremental Participation in Cooperative Involvement

Although there were occasions when married participants had come to a joint decision to engage in weight management efforts together, it was more common for women to collaborate with their friends or colleagues. For couples, although weight may be a motivating factor there is not necessarily a target weight being aimed at, instead they agree to participate in specific activities together to improve their health or the healthiness of their lifestyle, such as going to the gym together (P14), following a particular diet (P5, P15), or making an effort to go for a walk (P16). In contrast, co-operative efforts between groups of friends remain very weight-focussed, emulating the organisational structure of formal weight-loss programmes.

Seven of the eleven female participants actively trying to lose or maintain their weight belonged to one of four unofficial weight-loss clubs. The clubs are typically made up of approximately four friends or colleagues, although one was slightly larger due to its base on a hospital ward. All apart from one resembled the formal weight loss clubs, with a focus on dieting as the primary route to losing weight, including weigh-ins complete with recording of weight loss and gain. Despite many members of the other club being on diets,

its focus was on increasing and maintaining physical activity levels; they shunned the weekly weigh-in for twice-weekly hour–long walks. Participants' experiences of, and attitudes towards the weigh-in, varies greatly; it is motivating when weight is lost, embarrassing when weight is gained, inspiring when others lose weight, and satisfying when others gain. Although none of the clubs have the authority figure that official weight-loss groups have, the weigh-in serves as a weekly warning not to stray too far off course before progress is recorded again.

When the clubs are formed, members bring with them their previous experiences and knowledge of formal weight-loss programs. The clubs provide a shared resource for diets, eating plans, recipes and exercise classes, walking routes, etc. In some cases, these resources extend beyond weight- related information; in one group a woman brought in an eating plan that had been devised for her son who had Asperger's Syndrome, and some club members took it to help them reduce the number of additives in their own children's diets. In addition to such practical support, the time spent with other club members is deemed as allocated 'weight time'. During such times it is possible to complain about the diet and talk about your weight without fear of being a burden, something that prevented participants expressing their feelings to other peers:

> *I try not to talk about it. I talk more to you guys than anybody else. But I feel that it is such a constant, because it is such a constant thing with me I think that people are sick of listening to me. I deliberately try and not talk about it. And my husband, he is really… you know "oh you're fine, you're fine", you know, the fine thing. And my mum will say that "you're fine", and I am not fine because I don't feel fine." P9*

The following two sections discuss two information disclosure strategies that participants employed to maintain a degree of privacy while harnessing social support from their peers.

6.6.4.1 Secrecy and Disclosure

Varying degrees of secrecy were maintained on several aspects of interviewees' weight management: their actual weights, whether they perceived their weights to be problems, and their weight-loss plans and actions. P1 was quite unusual with respect to the degree of secrecy that surrounded her weight management. For the most part the most sensitive and private aspect of an individual's weight was the degree to which their weight concerned and affected his or her daily life. Self-consciousness and the fear of judgement caused some of our female participants to make excuses in order to avoid uncomfortable situations

including swimming, going on a night out and eating in public. Even in cases whereby an individual had groups of friends with which he or she would share dieting and weight-loss tips, he or she would either retain these most sensitive aspects, or only share with a member of the group in whom he or she had invested a great deal of trust:

> *I spend a lot of time with her at work and I know she wouldn't say to anybody. I think it is more of a thing that you know you can confide in them and they wouldn't tell anyone else. P5*

P3's story is illustrative of many of the emergent themes and strategies relating to secrecy and disclosure during weight loss:

> *Just now I keep mine a bit private because I was a wee bit fat… I don't really care what anybody thinks but you get embarrassed because, if everybody starts saying 'oh god I didn't realise she was 18 stone 2', that would embarrass me.*

P3 had been dieting for 5 weeks when she was interviewed, and had lost 17lb from her original weight. Colleagues at her work had formed a 'diet club' in which each shared diet plans and participated in a weekly weigh-in. Every Tuesday after shift handover, all club members would go into an office and an allocated member would weigh each one, recording weight loss or gain in a booklet. Because she wanted to avoid the embarrassment of quantifying her weight, P3 performed the weigh-in in secret with a trusted party. Other members of the club did not know that she was participating, and it was only when her weight loss progressed and they started to notice, that P3 was prepared to 'come out' and start publicly participating in the group.

6.6.4.2 Incremental Participation

The process of disclosure often progressed or regressed incrementally, depending on the interviewee's progress towards his or her weight-related goals, the relative comparability at a given time, or on how previous disclosure attempts had been received. In cases where friends and family responded to initial expressions of concern about weight-gain with statements such as "don't be daft", "you are fine" and "there is nothing wrong with you", participants were highly reluctant to approach those individuals again.

Similarly incremental was the degree of participation in collaborative efforts to lose weight. By its very nature participation incurs a level of disclosure unless, like P3, participation begins in secret. Incremental participation also suggests partialness, and

partialness like disclosure may progress or regress at any one point in time. For some partial participation was a static choice, P4 chose not to get involved in the weigh-in with her colleagues. Unlike P3 who avoided the weigh-in out of embarrassment and intended to join in when she reached a more acceptable weight (as judged by herself), P4 did not measure her progress through weight but through how she felt in herself and the fit of her clothes (a sentiment also shared by P5). Likewise adherence to diets would waver over time, some participants choosing to participate in weekday dieting, giving themselves the weekend to enjoy otherwise forbidden luxuries.

Incremental participation was not a behaviour restricted to the female participants, nor to co-operative involvement. When P15 and his partner agreed to try and lose weight together, she joined Weight Watchers and he followed the diet. His participation over time progressed from dropping her off at the classes and waiting outside in the car, to dropping her off and waiting inside, to eventually joining in the classes with her. Over time he lost ~1½ stone but found he was not progressing past 14 stone, which is when he decided to take up cycling and stop attending the classes. Similarly when P15 initially invited his brother to come cycling, his brother was reluctant to go cycling with him for fear of slowing him down, but once engaged in the activity together participated in friendly competition with each other that kept them motivated both on and off the bikes:

> *I had a mountain bike at the time and he had a really old bike. So the next week he had bought the next model up from me. I had the GT something, and he bought the dearer one… It's like, if [partner] puts a cake down or a dessert down I am like… 'oh… I would rather just leave that'. I am thinking about, like, going out on the bike at the weekend, and it kinda puts me off. You know? It's quite good that way… I am quite competitive with my brother.*

However, incremental disclosure was not such an issue for the male participants who displayed a much more all-or-nothing approach to sharing weight management efforts and issues with their colleagues.

6.6.4.3 Summary

As was discussed earlier, the time spent together at work and the common ground of concern with weight makes female peers ideal weight management partners. However, they rarely act together, instead coming together to talk, weigh and reflect. Again, we suggest that this is a reflection of the social structure of their lives. Despite the amount of

time spent at work, life is typically associated with life outside work, and so while work is an ideal venue to talk about weight, changes take place at home.

Collocation means that, theoretically, couples are ideally suited to act together. However, in cases where only one of the couple is concerned about weight or making behavioural change, co-operative weight management efforts are unlikely. Here the 'best-case' scenario would be that the spouse would become proactively or supportively involved. Lifestyle and activities themselves are more suitable focuses of behavioural change efforts in these cases, to enable a mutually supportive and co-operative approach.

As was illustrated in this section, collaboration is not an all or nothing affair. Relative comparability was used as a mechanism for determining levels of disclosure for reasons of privacy and the protection of others. Incremental participation in group activities somewhat resembles the process of legitimate peripheral participation in communities of learning described by Lave and Wenger [149] and gradual engagement with online communities described by Preece, Nonnecke and Andrews [196]. The similarities reinforce the earlier observation of the multiple meanings of weight. People learn weight management from their peers, taking on the identity of a weight manager through their affiliation with the community of practice.

6.6.5 Peer Involvement: A Summary

Obviously, we do not suggest that individuals are merely sheep who follow the herd. Their desires may conflict with the social norms of their peer groups, in which case an individual may decide to 'go it alone'. Nevertheless, the very fact that they are going it alone is a result of the passive involvement of their peers. As was said earlier, peers may be unaware of their involvement; this is especially true in the case of passive involvement. Talking explicitly about weight and weight management is a common form of passive involvement most frequently observed between female friends and colleagues. Men's talk tends to take the form of friendly banter, but it is influential all the same. A peer's lifestyle, habits and interests also contribute implicitly to an individual's social capital that he or she may subsequently draw on. In this respect, passive involvement lays the foundation for weight-related behavioural change while being a prerequisite for alternative forms of involvement.

When a peer invites an individual to join him or her in participating in a particular activity that may contribute to their weight management efforts, the peer becomes actively

involved. Unlike dietary-related active involvement, such as encouraging a friend to come along to a slimming club, physical activity-related active involvement does not necessarily rely on the peer engaging in weight management him or herself. Active involvement presents opportunities, or strategies, for weight management that the individual may not have considered otherwise. In contrast, supportive involvement eases an individual's existing weight management efforts. Supportive involvement typically takes the form of facilitation e.g. planning and cooking meals, or participation e.g. following the diet.

Alternatively, an individual and his or her peer(s) may make a joint effort or decision to engage in weight management. Such co-operative involvement typically involves spouses or groups of female friends/colleagues, where all parties are interested in managing their own weights. Co-operative involvement is not an all or nothing affair. Those involved do not necessarily collaborate in all aspects of each other's weight management efforts; selective participation is often governed by feasibility and personal preference. Individuals can also become gradually engaged in collaborative activities through incremental participation.

Thus, passive involvement forms the basis for an individual's awareness of and attitude towards weight and weight management strategies, and proactive, supportive, and co-operative involvement all encompass ways in which peers can become actively involved in an individual's weight management efforts. While such involvement is welcomed and regarded positively by individuals, the remaining two forms of peer-involvement are regarded less so. Although apparently the converse of each other, inductive and obstructive involvement share the similar traits of ambiguous and misguided intentions. They also highlight the ethical aspects of weight management that are not immediately evident when considering the previous forms of peer-involvement. Inductive involvement typically takes the form of verbal comments made by relatives that are, or are perceived to be, intended to instigate weight management. Whether the comments are made about an individual's appearance or about the possible health risks associated with the individual's physique, they are easily perceived as offensive. Although it is tempting to judge such comments by others as thoughtless and immoral, there is the counter-argument that it is sometimes necessary to be cruel to be kind. Regardless of intention, whether the comments are made out of care or malice, for the most part they appear to be ineffective in prompting change. Similarly, despite any well meaning or justified intention behind peers dismissing an individual's concerns about his or her weight or behind men offering their spouses a 'treat'

while they are dieting, such obstructive involvement is frowned upon by the individuals themselves.

6.7 Discussion

This study set out to investigate if and how people who are trying to lose weight harness the support of their surrounding peer groups. Not only did we find that the very practice of weight management is embedded in social relationships, but we also found that attitudes towards weight and weight management strategies reflect both societal and social norms. The remainder of this chapter is structured around the three topics that were used to frame the findings presented above: motivation, implementation, and collaboration. The discussion surrounding each of the topics presents a consideration of how technology does, could or should contribute, and where applicable, the ethical implications of technological intervention.

From a technological perspective, the motivation theme will be of primary concern for those interested in designing technologies to promote and measure behavioural change, while the implementation theme gives insight into the reasoning behind and practicalities of particular weight-loss strategies that would be of interest to those interested in the representation and accountability of strategy within systems that facilitate behavioural change. In the discussion of weight management as a collaborative activity, the collaboration theme puts forward alternative genres of the everyday behavioural change applications already discussed in Chapter 3, and the existing information disclosure practices of the study's participants are proposed as potential models for future privacy frameworks that balance the tension between harnessing social support and maintaining an individual's privacy.

6.7.1 Motivation: multiple meanings of weight and changing measures of success

The medicalisation of weight brings with it the presumption that correcting weights that deviate from what is normal, or the maintenance of weight within normal limits, is uniformly a good thing. However, it was unsurprising to find that health concerns were not the motivating factor behind most of our participant's weight management efforts. Appearance drove the initial efforts of all but two participants and, while many of the men subsequently found an appreciation for the physiological benefits of losing weight and increasing fitness. For women, the focus remained on weight and appearance. It could be

speculated that the male participants were overplaying the importance of fitness because fitness is a more traditionally acceptable topic of concern for men than appearance. However, they had been quite honest about fleeting moments of concern with their appearance and the fact that appearance had driven their initial efforts, and the shift in focus was further reflected in their talk of performance and competitiveness.

Considering the fact that the majority of male participants were obese prior to making behavioural change, it could be inferred that men in particular need to be more aware of their weight in order to stimulate change earlier. If that is the case, then the fact that over half of the women who disclosed their BMI were of normal weight prior to and during sustained weight management efforts suggests that women are over-aware. Warnings[20] such as the Nintendo Wii Fit ™ avatar (see Figure 6-3) whose physicality increases or decreases depending on the BMI of the player, may prove ineffective, because participants routinely became aware of their weight when trying on clothes, for example, and while such warnings were quite effective at promoting bad feelings, they were rarely attributed to prompting behavioural change.

Figure 6-3: BMI Influenced Nintendo Wii Fit ™ Avatars

We found many different examples of weight-loss catalysts. Many of our female participants chose to focus their weight-loss efforts on an upcoming occasion. Occasion-based efforts were also the most obviously appearance-based, and because of their finite timescale were also the least likely to result in longstanding change. Many knew that once

[20] We make the presumption that the physicality of the avatars is intended to be motivational, in a similar manner to the presumed motivational reason for the participation and progress charts that are included in the Nintendo Wii Fit ™ interface.

they reached their goals they would revert back to old habits or at least a variant of their current behaviours. Sustainable changes do not have as quick an effect as more drastic changes, and so the associated difficulty of making more drastic changes positively affirms the work ethic of weight management.

Given the fact that people generally aren't motivated by health to lose weight, the question is raised as to whether interventions should harness the power that appearance holds, and try and motivate by looks. On the one hand it seems quite unethical to tap into people's insecurities in order to prompt behavioural change, but on the other hand if the change then increases their health, which then may become the focus of sustained behavioural change efforts, then doesn't the individual stand to benefit? An alternative route would be for the focus of technology to shift temporarily, and for the objective to be to change perceptions of health and body image, such that health becomes more important and body image second.

The most health-related weight-loss catalyst was the realisation of the need to take care of yourself, as you get older. This compensatory lifestyle management echoed the findings of our initial explorations in the field of motivational issues, and so suggests that this may be a fruitful avenue of research. This involves accepting that people may reject the gold standard of health behaviours, and presumes that they will seek to negotiate the behaviours that they are happy to strive to achieve or maintain. The topic of negotiation is revisited in the next section.

It would be understandable for one to presume that the goal of weight management would be a target weight. However, target weights only accounted for the weight management goals of five participants (~26%). More frequently individuals aimed to be able to fit into specific sizes of clothes, or the overall goal of weight management was much more subjective in nature: stopping before they look too gaunt or continuing until they felt comfortable in themselves. In many weight-loss forums, members often declare their total weight-loss or weight-still-to-lose through a graphical 'ticker' such as the one shown in Figure 6-4. Although there are very few systems other than tickers in which progress towards weight-loss goals is explicitly represented, the problem of representing progress is made much more complex when the overriding goal is something as subjective as look or feel. Unless efforts are made to include more subjective measures of weight management, or to support people's interaction that helps them express or react to that look or feel, systems become disproportionately biased towards the objective.

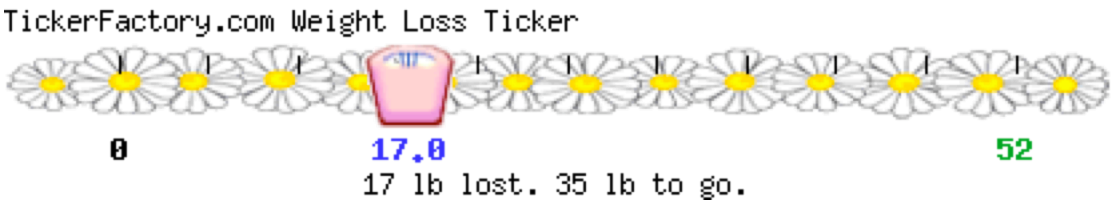


Figure 6-4: Example Weight Loss Ticker

When considering the representation of objective goals such as target weights and clothes sizes, the facilitation of incremental goal setting, as included in the physical activity goals of Fish'n'Steps [153] and Houston [72], would appear to fit with the existing practices of the participants. Additionally, it became apparent that in some cases the goals of weight management changed over time, particularly when people realised the health benefits of their weight loss. In such cases maintaining the health-related behaviour took priority over the task of losing weight, either because of a focus on fitness/performance or the development of a healthy lifestyle. We suggest that current approaches are ideally suited to when health-related behaviour is the focal point of efforts, in that they promote sustained development of 'good' health-related behaviours and habits. Revisiting the juxtaposition of health-driven and appearance-driven weight management, if we are to take the ethical stance that health takes precedence over appearance then a challenge lies in how weight management systems can guide such transitions in focus, and how they could identify and adapt when the transition has been made. Again there appears to be a need for adaptation, in this case to support the transition between goals.

6.7.2 Implementation: a matter of choice, preference, perception and control.

There are two ways in which the participants' choice of weight management strategy can guide future research in this area. Firstly, the prioritisation of dietary intake over physical activity highlights promotion of physical activity as an area for potential intervention. Secondly, the contrast between those who appreciated the rigidity and discipline of formal approaches to weight management and those who preferred flexibility and autonomy suggests the need for a range of degrees of structure and regulation within the design of weight management-specific everyday behavioural change technology.

Modification of dietary intake was a more commonly used strategy than increasing physical activity. As found in previous studies [178], including our own (see Chapters 4, 6 and 7), lack of time and a dislike of physical activity were two common barriers to

adopting physical activity as part of weight management. A less frequently cited barrier was the disbelief that exercise could contribute, although this was also found in the Families at Risk study (Chapter 7). In comparison, we all have to eat and so time is less of an issue, and modifying dietary intake does not cause the same physical discomfort that physical activity can do (apart from hunger in some cases). While exercise can be seen as a supplementary activity to daily living, eating is altogether the opposite. Food plays an integral part in social lives and cultural identities, and at a much more basic level, we all must eat to live. As we have to eat, modifying our diet does not appear to place as big a burden on the individual as becoming more physically active. We are simply modifying an existing behaviour rather than introducing a new one.

However, physical activity is an integral part of our daily lives, but it is not necessarily what people call 'exercise'. Indeed, even in those who did employ physical activity as part of their weight management, there was no evidence of people consciously raising activity levels through everyday activity (as was the case in Chapter 4). Perhaps, given the notion of weight management as work, increasing everyday activity seemed too easy; people instead chose to participate in sports or go to the gym. Personal preference does go some way to account for this, but the role of the marketing industry must also be acknowledged. Gyms and weight-loss organisations spend millions selling a product, but they don't sell a walk to work[21]. While the lack of association between everyday activity and exercise is not a problem for those who do participate in sports or go to the gym, it does seem to be obstructive to those who do not enjoy going to the gym or consider themselves 'sporty'.

We suggest that activity-monitoring systems have the potential to address the misperception of everyday activity not being contributory to health, wellness and (with respect to this population) weight-loss. A feature to add to such systems, in order to better suit them for this particular problem, would be the contextualisation of monitored physical activity to illustrate its actual value or lack of. For example, monitored activity levels could be presented with respect to the amount of time spent in contributory exercise (at least moderate exertion for at least ten successive minutes). Similarly, monitored activity levels could also be presented alongside comparative equivalents that are more traditionally associated with weight loss. An example would be to equate the time spent walking today in terms of having burned the same calories as n press-ups.

[21] Although everyday activity is currently the subject of an advertising campaign by the Scottish Executive.

Additionally, technology can be used to foster social capital in a way that it promotes exposure to alternative types of physical activity. Here are two examples from this study of how exposure to activities through others assisted in physical activity behavioural change:

- Even though P2 stated that he essentially made behavioural change alone, he acknowledged that having people around him who were playing frisbee/swimming/running made it easier

- P18 was given free access to a gym by his GP. By initially going to the gym he observed the circuits class which he would not have otherwise thought of attending, he now participates in 3 times per week

In the motivational issues survey presented in Chapter 4, a participant did not enjoy sports at school but then discovered outdoor pursuits through a team-building day with work. If we are not introduced to sports at school that we enjoy then when/how are we? This is where technologically facilitated social capital could contribute, by exposing individuals to alternative perspectives of physical activity. Moving away from social capital but continuing with the theme of exposure to sources of physical activity, location-based systems could also highlight activities that occur in one's local area.

When considering dietary intake, participants were somewhat divided into two camps: those who followed the diets prescribed by weight-loss organisations, and those who rejected the notion of diets—the latter describing their strategies as reducing intake, cutting out snacks, healthy eating, etc. Those against the notion of diets yet restricting their own dietary intake specifically rejected self-monitoring; thus hinting at the restricted scope of current dietary applications that were discussed in Chapter 3, which tend to rely on self-monitoring.

The permeation of weight-loss organisations throughout society means that one does not even have to attend to 'benefit' from their programs. Through their own experience or the experience of peers, women in particular now have a toolbox for devising dietary plans and ways to monitor their progress. There was a contrast between those who needed the rigidity of a formal weight-loss program, and those who negotiated their own strategies using the aforementioned toolbox and overall flexibility in attitude. When considering those who appreciate rigidity and discipline, parallels can be drawn with workflow systems and it is suggested that such an infrastructure could benefit any system built for them. In

contrast, the ability to dynamically adapt and tailor strategies within everyday behavioural change technology would more likely be of use to those taking a more flexible approach to weight management.

6.7.3 Collaboration: the scope and mechanics of peer involvement

Groups of colleagues and members of unofficial 'clubs' such as the ones found during this study seem to be the most obvious beneficiaries of existing sociocentric activity systems, and potential dietary equivalents. Our observations of gender-specific practices lead us to infer that supporting female members in maintaining mutual awareness of efforts while apart could extend the emotional support that the group provides, especially at times when an individual is feeling isolated, while a more masculine approach would focus on highlighting opportunities for collaboration of efforts and competition. The apparent lack of overt competition between female participants suggests that competitive games may be unsuitable as a means for health promotion for women. It may not be that competition is irrelevant to women, though; it could still be covert or implicit in their comparisons with each other. Either way, systems designed for such groups should be different while avoiding simple and static stereotyping: people should be able to shift or choose between different forms of interaction. In contrast to gender stereotyping, a challenge would be to promote gender-balanced interactions, such that women currently flooded with emotional support receive more proactive interventions, and vice versa for men. It should be noted that the tendency of women to discuss their weight and discuss diets might be a reflection of the fact that diet is a socially acceptable topic of conversation for women. Equally, physical activity lends itself much more easily to collective action than dieting does. Here we suggest that gender does not predispose women or men to discussion and action respectively, but that these tendencies are socially constructed and can therefore potentially be reconstructed via technology.

While the 'clubs' proved to be a source of existing support and inspiration for many of the design ideas presented here, 'the family' proved to be an area of opportunity. There was evidence that spousal involvement often extended beyond the moral support of weight loss efforts to facilitation, proactive encouragement to engage in an activity with them, and to joint decisions to make changes together. For the remaining participants, systems aimed at improving the daily activity levels or dietary intake of the family 'as a whole' could reduce the obstacles faced by one individual trying to change his or her daily routine while the others remain the same. When only one member wants or needs to make changes, a system

that raises awareness of the time needed to make those changes could prompt or challenge family members to help out. For example, the Whereabouts Clock [48] is an ambient interface for the home that displays each family member's current location and allows members to send messages to the household. A similar home-based interface could be imagined that conveys the domestic routine of a family in terms of the duties and activities of each family member. When a family member needs or wants to make changes to their own routine then the temporal demand of making that change (to go and exercise) and any impact on collaborative activities (making and eating dinner) could be shown on the interface. This would highlight any areas of conflict and might encourage family members to contribute, either by getting involved in the activity itself or by alleviating pressure from the individual in order to free up time for them. The ambient nature of the interface avoids the need for individuals to make direct requests for assistance; something that participants currently seem reluctant to do. However, it should also be noted that such a system would involve a degree of disclosure of intention and desire to change. Whether this issue would prevent such a system being adopted or whether it could be addressed through selective and incremental disclosure mechanisms remains to be seen; such a question can only be answered through further research.

Peer Involvement	**Technological Support**
Passive	An application that highlights and compares the weight management strategies, progress, and experiences of individuals who are comparable to the individual. It could be restricted to existing peers, but if seeking to increase an individual's social capital could extend to non-peers of similar demographic and location.
Active	
Obstructive	Not obviously suitable for WM, but a possibility is to include a 'nudge' function for peers to use to suggest to the individual that they are taking things too far/too seriously.
Inductive	Not suitable for WM
Proactive	In a game-based application, one of the objectives of the game is to recruit a new participant to take part.
Supportive	An application to highlight a peer's current and potential role in supporting or hindering an individual's efforts, and provides hints and tips on how to be more supportive.
Cooperative	A collaborative weight journal that allows for collaborative goal setting, planning, and progress monitoring. It could also include a collaborative session scheduler that integrates each individual's schedule to highlight mutually convenient times. Such a journal could be weight or behaviour-focussed.

Table 6-3: Designing to Support Various Forms of Peer-Involvement in WM

Considering the various levels of peer involvement identified in Section 6.6, that ranged from inactive (yet supportive) to proactive, it is interesting to note that current approaches tend to fall under the banner of co-operative involvement. We suggest that efforts should be made to account for other forms of peer involvement in system design, although it would be beneficial to first investigate the effectiveness of each form in order to prioritise future work. The previous suggestion of the 'social capital' system (see Section 6.7.2) is an example of how the activities of peers could serve as inspiration for an individual's weight management strategy and in that sense serve as a form of passive peer-involvement. Table 6-3 gives some examples of how the various forms of peer involvement could be supported in design.

Five areas of potential disclosure emerged during this study: weight, perception of weight as a problem, weight management plans, actions and progress. Disclosure strategies ranged from secrecy to selective, partial and incremental exposure. Male interactions tended to focus less on the problems of weight and weight loss, instead displaying proactive tendencies to get others (be it partners or colleagues) involved in the practicalities of weight loss: taking up sports and making dietary change. Both male and female participants displayed incremental participation in weight-loss activities, as well as online and offline communities. As was mentioned earlier, such behaviour resonates with the CSCW literature surrounding the practice of learning to be a member of a community through initial observation and gradual engagement [149, 196].

The design implications of such observations vary depending on the type of system being developed. If the system is a weight-loss system, there is a degree of declaration in its use alone. That itself may prevent uptake by those reluctant to declare him or herself as having weight problems. Lifestyle systems may then be more effective in those cases as it would allow a degree of weight anonymity, while more action-based systems respect the implicit understanding of the underlying problem and channel focus or energy into the proposed solution. Regardless of how the technology is packaged, selective disclosure and incremental participation should be considered in the design of its social interface. The dynamic nature of disclosure and participation raises specific challenges and questions. If to be managed automatically, perceived loss of control may prove to be a barrier to adoption. If to be managed manually, the system should be easily configurable such that its use does not become laborious.

The relative comparability of individuals and their weight management found during the study provides a good grounding for any automatic implementation of selective disclosure. While groups of already established friends are aware of their similarities and differences, larger technologically facilitated groups could benefit from the discovery of or affiliation with comparable people through an automatic social networking mechanism. In addition to the total or desired weight loss included in the Tickers mentioned earlier, other aspects of context to be considered are actual weight and size (to compare with self and validate the target as realistic or not), previous successes and failures, age and lifestyle. Such mechanisms of comparison would mean that members of facilitated groups can make informed choices about with whom they share advice or whose example they follow, in the same way that people who know each other already can.

6.8 Conclusion

This chapter presented our study of weight management as experienced by a broad demographic of individuals. We found that, despite the social stigma associated with the overweight and obese, for the most part weight management was very much a social activity. Peer groups would discuss weight and share strategies to lose weight; the nature of such discussions appeared to be gender-influenced. The social nature of weight management does not mean that individuals share all aspects of their weight management with their peers; we observed information disclosure practices based on relative comparability and incremental participation in group activities. The majority of participants were motivated by appearance rather than health, although in some cases an appreciation of the improvements in physical fitness and enjoying participating in a sport had provoked a shift in focus.

The chapter highlighted the multifaceted nature of weight and weight management, the various motivations behind weight management, the multiple meanings of weight and the broader context of weight loss that is considered when interpreting measures of progress and success. We argued that if technology is to resonate with these perceptions of weight, it should avoid becoming disproportionately biased to the objective. From the discussion in the previous section, we can derive the following recommendations with regards to *representations of weight and weight management* in everyday behavioural change applications:

- In addition to the total or desired weight loss, other aspects of context to be considered are actual weight and size, previous successes and failures, age and lifestyle

- Include subjective aspects of weight management, or support interaction that helps individuals express or react to their progress

- Support transitions in focus between non-health and health-related motivations, goals, and actions

- Avoid the inclusion of warnings in interfaces

The chapter also provided an insight into the diversity of weight management practices and attitudes towards the classic weight management issues of discipline and self-regulation. We agued that such diversity should be accounted for in system design and offered three design guidelines that reflect various degrees of *organisational structure*:

- Infrastructure should be based on the style of workflow systems for those who appreciate rigidity and discipline

- Infrastructure should be based on adaptive map-based systems for those who take a more flexible approach

- Allow for partial change

Throughout the chapter traditional notions of gender and gender-biases towards weight, dietary intake and physical activity were observed. There is an abundance of research in the sociomedical literature relating to gender and weight which has only been touched on briefly in this thesis, but while applications have been developed for a specific gender (female) [72, 238], little consideration has been given to the broader implications of gender in everyday behavioural change technology. The findings of this study point to three suggestions for investigating gender in weight management applications, the first two propose gender specific approaches while the third recommends explicit consideration of how *gender* is dealt within in such systems:

- To emulate a feminine-approach, maintain mutual awareness of efforts while apart to extend the emotional support that the a peer group provides

- To emulate a masculine-approach, focus on highlighting opportunities for collaboration of efforts and competition

- Avoid simple stereotyping and consider whether the aim is develop gender-based or gender-balanced interventions

The chapter supported the argument made in Chapter 4, that the straightforward broadcasting of behavioural data does not account for the complexities of the social dynamics of health-related behavioural change. The chapter argued that the broad scope of *peer involvement* is worthy of further investigation as inspiration for genres of peer-based weight management technology:

- Develop applications that support or emulate the various passive and active forms of peer involvement

The insight gained into the information disclosure practices of individuals engaging in weight management leads us to make the following recommendations for managing *information disclosure* in collaborative weight management systems:

- Facilitate incremental participation in group-based designs
- Selective disclosure should be included in the design of social interface
- Automatic implementation of selective disclosure should be based on the relative comparability of individuals and their weight management

Prompted by the various perceptions and misconceptions of health-related behaviour that were observed in the study, this chapter also argued for the use of alternative approaches to relying on motivation through monitoring behaviour as a strategy for promoting health-related behavioural change. The three *alternative strategies* are:

- Augment monitoring technology to illustrate value of physical activity
- Challenge common perceptions of health and body image
- Design to foster social capital in a way that it promotes exposure to alternative types of physical activity
    - Expose individuals to alternative perspectives of physical activity
    - Exploit positioning technology to highlight opportunities to participate in local activities

The everyday nature of weight and weight management appears to have led to a democratisation of weight management resources, strategies, and choice—unless individuals specifically want to surrender control to a formal weight management programme. This prompts us to suggest that weight management is an appropriate domain

for the application of the everyday behavioural change technology discussed in Chapter 3, although the broad scope for potential interventions that this study has highlighted is yet to be fully explored. In a departure from our efforts to support existing practice, the chapter has argued for interventions that address misconceptions of exercise and that promote exposure to alternative types of physical activity. The recognition that individuals make behavioural choices based on their experience and exposure to particular behaviours is a first step towards moving from a persuasive paradigm to one of negotiation.

7 Families At Risk

In this study we explore everyday behavioural change within families of low-socioeconomic status. The community in which the study took place was the subject of a recent study that found that 87% of preschoolers were exposed to at least one modifiable risk factor for cardiovascular disease (CVD): the two most common risk factors being poor dietary intake and physical inactivity [24].

7.1 Introduction

Considering health-related behavioural change within young families is interesting from a social perspective, because of the dependency that children have on their adult caregivers (parents, grandparents etc) for nutritional intake and physical activity. Furthermore, while poverty, or broadly socioeconomic status, is something seldom considered in HCI, in terms of health it is a dominant determining variable. Simply put, income and social class are the major factor on life expectancy after gender and ethnicity [45]. Low-income populations, then, stand to benefit greatly from technological interventions in this area but financial constraints may render such interventions infeasible. Here we investigate the 'messiness' [25] of the sociotechnical landscape where technology may have a positive impact. The aim of this study is to explore the potential for sociocentric technological interventions that promote health-related behavioural change specifically within families of low socioeconomic status.

The methodological approach employed in this study is presented in Chapter 5, although we continue this chapter with an explanation of our decision to augment the inductive analysis employed throughout the three core studies with an application of the Transtheoretical Model of Behaviour Change (TTM) [199]. We then proceed in section 7.3 with an overview of the related literature specific to this domain to complement the literature reviews in Chapters 2 and 3. In Section 7.4 we describe the community outreach project through which we recruited the study participants, and Section 7.5 presents the study participants. As was explained in Chapter 5, the findings are structured around three topics: motivation, implementation and collaboration (Sections 7.6 to 7.8). Section 7.9 discusses the implications for technological research and design in this domain.

This study was carried out in collaboration with Katie Siek. The author collaborated with Katie in the design of the focus group and interview schedules, data analysis and writing up of findings for publication (one accepted [160] and on in submission). The author carried out the focus group and all of the interviews, and is the primary author of the two publications that the remainder of this chapter is based on.

7.2 A Methodological Aside

In this study we augmented our inductive analysis with an application of the Transtheoretical Model of Behaviour Change (TTM) [199]. We did this to help us interpret our findings within the context of the participants' current attempts to make dietary changes. The reason that we felt it was necessary to do this for this particular study and for just one of the problem behaviours was down to a matter of complexity. Attitudes towards physical activity were relatively consistent and unlike the Families at Risk participants, the majority of participants in the other studies were actively engaged in some degree of behavioural change. Put simply, the TTM helped us make sense of the data where it was felt necessary but did not define or drive the analytic process. The problem of forcing data into pre-organised categories that was discussed in Chapter 5 was aptly illustrated in this study, in which we found that many participants did not fit into any of the TTM's categories. Instead of forcing the data into an inappropriate category, we chose to define another category. This is discussed further in Section 7.5.

Rather than assess stage of change based on stage-based questioning or questionnaire responses, we chose to categorise participants based on evidence of their behaviour and behavioural intent that arose during the interviews. We chose this approach, which has

previously been employed by Lin et al. [153] because: (1) the majority of validated questionnaires focus on one particular dietary behaviour e.g., fat-intake and (2) direct questioning about their intention to change could be perceived as more judgmental than if the same information was elicited during the flow of conversation.

7.3 Background

Cardiovascular disease (CVD) takes many forms: high blood pressure, coronary heart disease, strokes and heart failure. Although the incidences of CVD deaths in the US are decreasing, CVD remains the biggest killer in the US (accounting for 37% of all mortalities [6]), and more importantly for the focus of this work, remains most prevalent in communities of low socioeconomic status. Furthermore, a recent study by Barton et al. [24] found that 87% of children in low-income families were already exposed to at least one modifiable CVD risk factor by preschool age (3-5 years old). The two most prevalent risk factors occurring within the preschool population were fat intake (67%) and physical inactivity (40%).

Poverty is inextricably linked with ill health. Considering CVD and dietary intake alone, it is widely accepted that socioeconomic deprivation impacts the poor on a number of levels: the individual, community, organisational and governmental. On average, over half of the produce evaluated by the United States Department of Agriculture (USDA) was found to cost less than $0.25 or less per serving [204], that would seem to suggest that fruit and vegetables are accessible (both physically and economically) to families of all socioeconomic classes. However, relatively few grocery stores are found in poor areas, and those that are tend to be more expensive than in other areas [67]. The ‘social patterning’ of dietary intake was found in a UK survey [126], whereby populations who depend on benefits were less likely to eat healthy food items. Somewhat predictably, considering their dependence on their caregiver with respect to dietary intake, another study found that children as young as five display such ‘socially patterned’ food preferences [115].

Parents are generally the primary targets of the few initiatives aiming to improve the health of preschoolers. In spite of intensive face-to-face approaches results have been relatively modest: most programmes showed ‘some’ improvement in ‘some’ of the target behaviours [55]. Two such outreach programmes that currently serve our study population are

Headstart[22] and Women, Infants, and Children (WIC)[23]. Headstart is a national school readiness programme, providing education, nutrition and health services to low-income children and their families in the US. WIC is a nutritional programme that provides food supplements and education to nutritionally at-risk pregnant women and preschool children. The majority of these programmes occur in community settings, benefiting from the ability to reinforce the health promotion message through repeated exposure and multiple mediums. Despite their community settings, all of the programmes focused on individual rather than community-based change.

Lee et al. [151] raised the issue of tackling health promotion at an individual and societal level:

> *We can continue to advise individuals about their CVD risk factors, but we also have to acknowledge that deprived and less affluent neighbourhoods have a negative effect on the incidence and prevalence of CHD[24] in its many forms… the benefits of advising patients to participate in exercise and to improve their diet needs to be balanced by the availability of local resources.*

THRIVE—a Toolkit for Health and Resilience In Vulnerable Environments—has been developed to assist communities identify and prioritise resilience factors in their neighbourhood [76]. An unrelated, but illustrative, project can be found in the metropolitan area surrounding our population. Run by the Catholic Diocese of Denver, the Share Program[25] enables people to order from a list of twenty items that the program buys in bulk. The programme asks that participants volunteer with the programme for two hours per week, illustrating how resources can be pooled to overcome barriers to affordable food.

The range of technological interventions developed specifically for low-income populations have so far ranged from low-cost healthy eating information web-portals to interactive multimedia teaching modules e.g., La Cocina Saludable [135] and the cartoon-based Baylor GEMS Internet Intervention [236]. Each of these interventions illustrates how different aspects of the socioeconomic context of their target population can be integrated into the design of an intervention. In the case of La Cocina Saludable, a validated text-based nutritional education module was translated into Spanish and adapted so that the content was delivered through audio and graphics; thus eliminating the language

[22] http://www.nhsa.org
[23] http://www.fns.usda.gov/WIC/
[24] Coronary Heart Disease
[25] http://www.sharecolorado.com/

and literacy barriers faced by many of their intended users, low-income Hispanic mothers. The Baylor GEMS project also translated traditional health promotion messages into a culturally appropriate form, developed specifically for young African American girls.

The needs of underserved communities and populations have so far mostly been ignored in the wave of health-related persuasive technologies emerging from the HCI communities. The work being done by Khaled et al. [141, 142] is an exception, that offers insights into the alternative strategies required to persuade change within individualistic and collectivist cultures. Grimes et al. [116, 117] further advances the concept of culturally sensitive design in their research of technology to promote positive dietary behaviours within low-income African American populations, also calling for a consideration of the environmental effect of behavioural choices and culturally relevant behavioural modification suggestions.

Apart from Chick-Clique [238], which was designed for teenage girls, all of the persuasive technologies discussed in Chapter 3 were designed with adults in mind. Exergames, on the other hand, while not restricted to use by children, are much better suited to them. In contrast to the vilification of computer games with respect to their apparent role in decreasing childhood activity levels, exergames appear ideally suited to Burdette and Whittakers's [53] proposed approach of promoting physical play rather than exercise.

The most famous of exergames are undoubtedly Dance Dance Revolution™ (DDR) and the Nintendo Wii™. These were not initially designed with health promotion in mind but have proved effective in facilitating weight-loss for those who play them regularly; DDR being declared as a sport in Norway in 2003 and being introduced into the school curriculum in West Virginia in an attempt to combat childhood inactivity and obesity [129]. The Wii Sport is an excellent example of how well designed exergames and exertion interfaces can increase the physical activity levels of not only previously sedentary gamers [113], but also populations not traditionally associated with computer games [221]. In addition, researchers are investigating ways to instrument children's play areas [168, 260] and augment traditional sports [179, 180]. Mobile games promise to further enhance the potential for covert physical activity promotion whether developed specifically for that purpose [153] or for leisure [27].

7.4 The Bridge Project

The Bridge Project is a community outreach project with four centres situated within public housing neighbourhoods in which families often fall on or below the poverty level. The project provides after-school and summer school programmes for children within the neighbourhoods, and college and trade school scholarships. In the after-school programmes, children aged between 3 and 18 attend their local centre between 3 and 8pm each weeknight, and have the opportunity to participate in various activities including a literacy program, art classes, and technology education.

Figure 7-1: Bridge Project Community Outreach Centre

Due to limited resources health education is not a core component of the project's curriculum, but physical activity is encouraged through participation in team sports and outdoors leadership course. The children are given healthy eating education intermittently. During homework hour the children and are given a snack with a drink of fruit juice or milk. Somewhat anecdotally, a project employee commented that when the project first opened some of the children would not drink the milk that was provided because they thought it was poison.

7.5 Participants

We worked with administrators from the Bridge Project to recruit primary caregivers of children under eight years old who lived in the public housing community and spoke English. A total of 17 participants were recruited for the study. The participant group was primarily Latino (n=12), and included African American (n=3) and White (n=2) individuals. Although not exactly proportional, this sample does complement the most common ethnic orientations of the Bridge Project families (52%, 20%, 10% respectively).

All of the participants were women between the ages of 20 and 56 years old (average age = 32.3; s.d. = 10.1). The women were the primary caregivers for between two and five children (average number = 3; s.d. = 0.94) that ranged from one week to 16 years old. Three of the women were married, one was engaged, and 13 were single. Eight women were not working outside of their homes at the time of the interviews (one participant was on bed rest, prior to which she was employed), seven women worked full time, and two women worked part-time. Their out-of-home jobs included everything from sales associate to personal banker to janitor. The number of people in the participants' social networks that helped them care for their children ranged from zero (3 participants reported no one helped) to four (average social network size = 1.35; s.d. = 1.16).

When asked to define what it means to be healthy, all participants started their definitions with eating healthy and exercising. Sixteen patients mentioned the absence of disease as a sign of good health. Four participants specified the health of a specific body part (e.g., teeth or brain), four participants discussed limited medication consumption, and two participants mentioned the benefits of sleep as a sign of health.

From a technological standpoint, nine participants owned a computer, however 16 participants had access to a computer either in their home or at a community centre. Sixteen of the participants had at least one year of experience with computers—they felt the most competent with using the Internet and moderately comfortable with using word processing, email and chat programs. Thirteen of the participants owned mobile phones and used their phones daily. Those who owned mobile phones had at least two years of experience using their phone, and felt comfortable using their phones for making and receiving calls, sending and receiving text messages, and taking pictures with their phones.

When analysing the interview transcripts to categorise participants' stages of change with respect to dietary intake, it became apparent that Adams et al.'s [3] criticism of the TTM was relevant here (see Chapter 2). Many of our participants, although in precontemplation with respect to TTM, were only precontemplatives through lack of resources rather than motivation. For this reason we added an additional category of participant: *Forced Precontemplation*, with a generic definition of currently being unable to change, despite intent or desire to do so. As can be seen from Table 7-1, only four of our participants were precontemplatives. Five were in forced precontemplation. Although financial constraints were often expressed during interviews, the more frequent reason for forced precontemplation was not knowing where or how to start.

P3 was intending to make changes to her family's eating routine when she and her family moved to a larger house. P10 was in the process of gathering healthy recipes and planning family activities after being told by her doctor at a routine medical that she was overweight. P9 had recently started to cut out snacks from her children's diet after being told that her daughter was 50 pounds overweight.

Four of the participants had successfully made dietary changes following bereavement, exposure to ill health, or formal intervention through outreach programmes. The remaining participant who is not represented in this table, P4, grew up eating healthily, and therefore did not consider herself to have ever made a behavioural change.

For the most part (n=14), participants were happy with how active their children were and most commonly cited physical play as the source of their children's activity. Working and/or family life was the only source of physical activity for the majority of our participants. Some did integrate walking into their everyday routine e.g., parking the car at the furthest parking spot at work and walking to shops. Only five of our participants were actively making efforts to exercise, doing one or a combination of the following activities: a weekly walking routine (n=2), doing resistance exercises in the house (n=2), jogging (n=1), and going to the gym (n=1).

Stage of Change	Generic Description	Example Evidence	Participants
Precontemplation	No intention of changing within the next 6 months	I don't think I do [want to make dietary changes]. I'm not totally sure if I want to do it so that's why I really – I think that's why I keep putting it off maybe.	5, 11, 14, FG3
Forced Precontemplation	*Unable to change within next 6 months despite desire or intent to do so*	*Well there is a lot of things I would like to change but you can't afford it…. They raised my food stamps to I think 262 I think a month that is supposed to feed a family of four. There is nothing left, you know, so we skimp on the meats one month, just so we can buy the fruits for the kids.*	*6, 7, 13, FG1, FG2*
Contemplation	Seriously thinking of changing within the next 6 months	I am thinking about when I move to a bigger place that I want to make a menu, a weekly menu of what I want to make very week and paste it on the refrigerator, so the kids know what they are going to eat and they are prepared for it. That is what I am going to do.	3
Preparation	Intending to change in the next month	I'm going to try it. I'm telling you, I'm just going to get ready with all the research I started doing and print out everything that I want to start to know how to do and then from there on I'm going to try to see if I could achieve it. Hopefully I could.	10
Action	0-6 months after changing	I started [not buying snacks] the first of the year. I told myself that's my New Year's resolution, we going to lose some weight.	9
Maintenance	>6 months after changing	I don't feed my kids that anymore like I used to, like when they were young. When I was a teenager, like, "Oh, McDonald's. Here you go, here's dinner."	1, 2, 8, 12

Table 7-1: Participants' Stages of Dietary Change

7.6 Motivation

Driven by the exposure to ill health and bereavement, and the natural instinct of a parent to want the best for his or her child, altruism was the overriding motivation to change within this population. It became apparent very early on in the course of the interviews that of the two behaviours being discussed, dietary intake was of the utmost concern to the study participants. The participants were aware of the strengths and weaknesses of their family's dietary habits and were motivated to make changes, but lacked financial, strategic, and social resources needed to do so (see Section 7.7).

We found a stark contrast between participants' attitudes towards dietary intake and physical activity, and more specifically between attitudes towards their own physical activity and the physical activity of their children. Participants appreciated the value of physical activity as an intrinsic part of childhood, and encouraged physical play wherever possible. They were generally happy with their children's activity levels but expressed concern that their children's activity levels were greatly reduced during the winter months. Only five participants actively engaged in purposeful exercise; most of the remaining twelve acknowledged that they did not get enough physical activity but few explicitly expressed the desire or intention to become more active. Reasons given by the participants for reluctance to engage in physical activity were lack of time, exhaustion, and a disbelief that physical activity was of any benefit to them.

The remainder of this section is structured around the three themes that have just been introduced: the presence and awareness of lifestyle related disease, the importance of physical play for children, and the impact of busyness on caregivers' perceptions and practice of physical activity.

7.6.1 Living the Statistics

Echoing the health statistics that surround low-income populations, the majority of our participants lived with a daily awareness of ill health and bereavement caused by conditions associated with health-related behaviours such as low levels of physical activity and poor dietary intake.

P13 had recently been registered disabled due to multiple medical conditions. Two other participants were the main caregivers for their infirm mothers. In both cases the mothers

were disabled through diabetes-related illnesses. For P2, the younger of the two, the experience of looking after her mother through the last stages of her illness served as a direct motivator to look after herself:

> *I think my mom's health had a big factor in [staying motivated], so when we were growing up she was sick with diabetes and she did not have good eating habits at all and that is a big thing for me and it still is. I don't want to have diabetes and I don't want my kids to have it .P2*

P12 lost her 35 year old mother to breast cancer. Although she rarely thought about health until she had children herself, she was now highly motivated to keep herself and her children well. P8's family has a strong history of cardiovascular disease, none of her mother's side living past 55. Her aunt's recent death served as a catalyst for change for P8 and her mother:

> *I said we have to get serious… and she was like 'alright' and it kind of woke her up… my aunt was the healthiest one in the bunch and she still passed away, so it kind of scared my mom… And I told them I am not going to wait till I am 45, 50 to be healthy, I am going to do it now. P8*

Despite the relatively young age of our participants (32.3 years old, on average) many of them expressed concern about their weight, and reported related complications such as joint pains, general aches and lethargy, and breathlessness on minimal physical exertion. In two cases weight-related discomfort had prompted successful behavioural change, P8 losing 50 lbs. and maintaining that new weight and P10 similarly losing 25 lbs. and maintaining her new weight, neither participant now suffering from their original complaint. The majority of the remaining participants expressed a desire to change, but were limited financially or were simply overwhelmed by the size of the task; they simply did not know where to start. Some were actively preparing or had just started to make changes, but two were honest in saying that they just did not want to change.

Of the five participants not to report any concerns about their own health, P1 and P2 were both in maintenance; both had made behavioural changes under the guidance of the Headstart and WIC programmes during their pregnancies, spurred on by experiences with ill relatives. P4 had never needed to make dietary changes as such, and the remaining two participants were not affected by any of the aforementioned issues. They were both happy with their health and the health of their children, and had no experience of serious illness in their families. Both of these participants were, unsurprisingly, precontemplatives.

7.6.2 The Children: Activity as Play and Experience

For the most part (n=14) participants were happy with how active their children were and most commonly cited physical play as the source of their children's activity. Several participants identified limiting time spent in front of the TV and/or games console as a strategy to engage their children in alternative forms of play. Other organised activities such as attendance at the Bridge Project and going to the park were also perceived as contributing to their physical activity levels. Although some of the young children did participate in sports such as basketball and soccer, participation in sports tended to be reserved for the older children who were approaching their teens. When talking about their children's activity levels, the participants seemed to refer to mental and physical sources of stimulation. Attendance at Bridge, for example, does involve prolonged periods of sitting at desks and computers alongside intermittent bursts of activity. When asked if and how they would like to improve their children's level of activity some participants would talk about introducing new experiences rather that focusing on specific types/amounts of physical activity per se:

> *I think that would be fun, you know stuff like that, bring them somewhere where they can do mountain climbing, something different and keep them active every day... I would like to take them somewhere that would knock them off their feet, you know and then they come home and be tired, but that is the only thing that I would really like to change, put more adventure into every day, you know into every day playing. P12*

These participants in particular voiced a more holistic model of health than the absence of disease/medical model that was offered by many. Participating in activities (both exercise and experience-based) was viewed to contribute not only to the health of the child but was considered an investment in the future, both with respect to functional ageing and in becoming a socially confident individual:

> *I signed them up for a week-long camp with Girl Scouts, so they could do things that I didn't do when I was a kid to try to get out more and try to be more outgoing, because as a kid, I wasn't very outgoing and I think that is the reason why. FG1*

7.6.2.1 Bad Weather Blues

The detrimental impact of low-income urban communities on the physical activity levels of community members is well documented [151], but attitudes towards the safety of letting their children play outside the home were fairly mixed. There were parks with play

areas within the locality, but for some the availability of a space was not enough; dedicated areas and organised activity were called for. The interviews took place during the winter months and all of the participants stated that their children's activity levels were lower in winter than summer. The seasonal nature of activity levels is not unique to this population [192], but is somewhat exacerbated by cramped living spaces and the cost of indoor play activities. For some it was of great concern that they could not think of how to maintain their children's activity levels during the winter months:

> *I think that is the main concern with my kids, especially during the winter. During the summer, I can get them out doing whatever. During the winter, they are on the games, they are on the TV... How do we get them to exercise in the winter, unless you have a bike in the house or a treadmill and you can tell them to get on for 10 minutes or 5 minutes, what do you do? FG2*

7.6.3 The Caregivers: Busy Inactivity

Working and/or family life was the only source of physical activity for the majority of our participants. Some did integrate walking into their everyday routine e.g. parking the car at the furthest parking spot at work and walking to shops. Only five of our participants were actively making efforts to exercise, doing one or a combination of the following activities: a weekly routine of walking routes (n=2), doing resistance exercises in the house (n=2), jogging (n=1), and going to the gym (n=1). Of those not actively engaging in exercise, most acknowledged that they did not get enough physical activity but few explicitly expressed the desire or intention to become more active. This stands in stark contrast to the caregivers who were concerned that their children did not get enough exercise during winter, and the fourteen participants who wanted to change their dietary habits.

Lack of time and exhaustion were the primary reasons given for inactivity; other reasons included injury and/or disability. It is undeniable that many of the participants had extreme demands on their time; the majority were single parents looking after several children with some working multiple jobs. However, an additional barrier that we found was much less practical in nature: although physical activity was uniformly deemed to be an important part of childhood, the perceived value and importance of physical activity for the caregivers themselves was much less evident. When children engage in physical activity it is not only beneficial to the children but it frees up time for the caregiver and tires the children, thus reducing demands on the caregiver.

> *He plays basketball, he plays football – so he gets entertained over there. So, it's like, at least some – like that stress is like a little bit out of my hands because I know he's over there, I call him, he's doing okay, he's playing basketball, he's running, he gets home, he takes a shower, and he's worn out, he goes to sleep. P10*

For the already worn out and busy caregiver, engaging in physical activity does not appear to provide any equivalent benefits. While the participants did not express the belief that their everyday activities would improve their health, what was conveyed was a sense of disbelief that any additional exercise would make any improvement because they were already physically exhausted:

> *FG2- I don't know, I am pretty much on the go all day. You know I get people telling me all day, geez as much as you are running around this place, you would think you would lose a lot of weight and I think I have gotten into this routine for 24 years that I don't lose the weight, because I am very active. [The shop] is a very busy, busy place and you constantly moving and constantly running.*
> *FG3- I think it has to do with what you eat, because if you don't eat healthy, no matter how much you walk. Because I walk all day, I mean even at my night job, I am still cleaning offices and that and as long as I keep eating pizza, I keep eating McDonalds, and Taco Bell, I am not going to lose the weight.*

The notion that dietary intake is more important to health than physical activity had, in some instances, been confirmed during prior weight loss attempts where individuals had experienced little feedback when trying to lose weight via exercise as opposed to the 'success' that they had experienced when following diets such as the Atkins diet for a short period of time. While physical activity was seen as a preventative strategy for the health of their children, for the caregivers any prospective changes were primarily remediative, in the hope of losing weight. As such, physical activity was seen as a means to an end as opposed to being an end in itself, and weight loss was viewed as a measure of success. Additionally, physical activity was viewed to be an optional feature of everyday life. Standing in contrast to the correlation between physical play and childhood, exercise was associated with 'healthy' people and participation in exercise was seen to reflect a personality trait.

7.6.4 Summary

This section has illustrated the pervasive nature of health concerns and lifestyle related diseases within this population. The majority of participants had been bereaved or had looked after family members with chronic diseases. Many were themselves experiencing

ill health or physical discomfort, and were already concerned that their children were overweight. The majority of participants wanted to make dietary changes but did not know where to start. Awareness of the problem and desire to change, did not necessarily equip an individual for change. Those who had successfully implemented dietary changes had received practical assistance to do so through formal community outreach programmes.

Despite the concerns that were voiced about health and the desire to make dietary changes, participants were less inclined to consider making changes to the their physical activity levels. They valued the holistic benefits of physical play for their children and expressed concern when external constraints such as bad weather prevented them from playing outside. Yet there was a degree of disbelief that additional physical activity would be of any physical benefit to an already worn out caregiver. The perception that physical activity was of little benefit to the caregiver was further compounded by the belief that dietary intake was more important.

All of the issues described in this section go some way to explain the disparity between attitudes towards the importance of physical activity for children and for the caregivers themselves. Furthermore we suggest that the well-documented tendency for caregivers to place a higher priority on looking after the health of the family rather than the health of themselves [181], further reduces the perceived importance of a caregiver's physical activity levels, both in comparison to the importance of the physical activity levels of their children, and in comparison to dietary intake that directly affects the health of the whole family.

7.7 Implementation

A desire to change is generally a prerequisite to change, but does not necessarily precede change. Reflecting the prioritisation of dietary intake over physical activity as discussed in the previous section, the participants had little or no experience of attempting to implement change to physical activity levels.

When considering dietary intake, there is something of a context gap between the nutritional guidelines that are used as a basis of communication around this topic and the everyday practices and financial constraints of this population. While the food pyramid tells us what should be in our diet, it does not address the practicalities of buying, preparing or even eating the food. In low-income populations these details are of extreme

importance, as they do not have the space in their budget to allow any form of trial and error when it comes to buying and serving food.

Reflecting the much higher proportion of participant's experiences and problems of implementing dietary changes than implementing changes to physical activity levels, this section is concerned with barriers to implementing dietary change.

7.7.1 Beyond the Food Pyramid

Given the observed level of awareness with respect to the risks and consequences of poor dietary intake, and the overarching concern about the need to make changes, it would not be unreasonable to presume that an area of informational need is the nutritional components of a healthy diet. However, all of our participants were aware of the strengths and shortcomings of their diet. All of the caregivers had an awareness of 'good' and 'bad' foods, many referring to the food pyramid when asked about what constitutes a healthy diet.

It is one thing to be aware of the food pyramid, and quite another to be able to translate that into everyday dietary practices. Despite a desire to change, many of our participants were simply overwhelmed by the task of changing their families' dietary behaviour. In some cases they did not know where or how to start making changes, while P5 reported having made many enthusiastic attempts to change all aspects of her dietary habits; enthusiastic efforts which generally lasted for two weeks. While the food pyramid tells us what should be in our diet, it does not address the practicalities of buying, preparing or even eating the food.

While the family doctor was the most frequently cited and trusted source of information, they provided information that was of limited utility:

> *When someone hands you a sheet and tells you just to follow this and count calories and things like that and sodium, you are looking at them like "okay… do you want to hand me something I don't know how to read or even understand?" P6*

In some cases the anticipation of being recited meaningless guidelines was enough to deter our participants from seeking guidance from the doctor. Medical terminology was not the only factor affecting the delivery and response to health promotion education:

> *For some people living healthy is totally different than other people and what I don't like about it is they are trying to put everyone in the same category to live healthy… so if you can take getting healthy and kind of interpret it into their culture or lifestyle, I think it might be little easier. P12*

The cultural disparity between the message and the recipient was also compounded by the additional cultural disparity between the recipient and the conveyor. When discussing why some local families do not use the resources provided by the Bridge Project, one Project employee commented that, "They do not want more white women telling them how to raise their children."

Some participants used the Internet to answer questions they had about healthy eating. Four participants reported using the Internet to search for recipes, three of them specifically searching for healthy recipes while the fourth searched for recipes that used what she had left in the house. Reasons given by other participants as to why they did not use the Internet to search for recipes or general health information reflected the notion that the Internet was for things other than seeking help/advice, e.g., "mostly the Internet is for my email and to look up things that I think are interesting," and the complexity of searching for such information, e.g.,

> *I really wouldn't know how to go about looking for it. I would type in something and then get lost and lose interest in it.*

7.7.2 Waste Not Want Not

One of the most common barriers that prevented most participants from purchasing health foods was the fear of waste. Waste was defined in many ways—from family members not eating to food spoilage to risking money on new food items. Participants were highly sensitive to waste because with their limited resources, they had to consume each food item they purchase or risk the possibility of not having enough food for the rest of the month.

Picky eaters were the most cited source of wasted healthy food. Children in ten of the participants' households refused to eat healthy foods purchased, thus the foods would rot. In extreme cases, participants had given up on purchasing healthy foods. Predictably, three of the four participants in this case were categorised as precontemplative.

Those participants who had not given up on purchasing fruits and vegetables had the added challenge of finding a place to purchase unspoiled fresh food items. Participants discussed how the cheaper markets in close proximity to their homes had the lower quality fresh produce. Eight participants went to multiple supermarkets to get inexpensive staple foods at the cheaper shops and better produce and meat from more expensive shops. Unfortunately, going to more expensive shops decreased the amount of food they could purchase because of food prices and travel costs. Occasionally, participants would have to supplement their food supplies by going to food banks. Two participants told us that they had received spoiled food from the local food banks:

> *But then again when you go to food banks, …where they give you fruit and like bananas and stuff like that. Well, I went there and I got all the stuff home and I started looking at it and half the food was outdated. P13*

In some food banks, people do not have a lot of choices on the foods they select. Thus, people may have to get new foods that their families are not familiar with. In addition, when making a lifestyle change to eat more healthily, new foods most likely will be introduced. Three of the participants voiced concerns about wasting food if they attempted to cook new, healthier foods because their families may not eat the food. Thus, they would waste both resources to obtain the food and the food itself, as shown in the following quote by P12:

> *But I try not to cook too much that they ain't going to eat, because that is wasting food on my end and that is money, so I try to cook stuff I know they are going to eat.*

The participants in the active and maintenance stages of change were more likely to discuss fears of waste in terms of spoiled food and trying new food items. Based on their categorisation, we can surmise that they had more experience with purchasing and preparing healthy foods and thus had more of these experiences with wastage. Participants in earlier stages of change had more problems with picky eaters and were deterred from trying new foods because of waste fears.

7.7.3 Making Something Out of Nothing

Meal planning can help create a variety of healthier, well-balanced meals for less money and, it helps people save money while shopping because of fewer impulse purchases[26]. Overall, we found a fairly even mix of those who planned and those who did not plan their meals.

7.7.3.1 The Planners

Three of the participants who planned their meals did so because they were generally well–organised people, and understood the benefits of budgeting and time efficiency by laying out exactly what their families were going to eat for a specific period of time. The amount of time participants planned for ranged from two days to two weeks in advance. P1 openly displays her family's meal plan on a calendar on her refrigerator.

Participants who planned meals with their children openly discussed healthy and unhealthy foods. These discussions provided the children with opportunities to learn about health and budgeting. For example, a participant described how her entire family changed their eating habits when her live-in mother was diagnosed with diabetes.

> *I told the kids let's do it with grandma and show her we are all going to do it, so we just kept it going. So, it works, it is just hard sometimes. P8*

Another caregiver, P10, discussed how her children went from helping her plan meals to helping her cook the meals. However, as hinted in the above quote and will see in the following section, meal planning is difficult sometimes and requires time for organisation and forethought.

7.7.3.2 Barriers to Planning

Participants who did not plan meals commonly cited time constraints, lack of space, and financial uncertainty. Participants who did not have enough time to plan described excruciating schedules; they had more than one job and, after getting their children fed and put to sleep, only had fifteen minutes for themselves:

[26] According to the USDA leaflet for low-inome families 'Book Recipes and Tips for Healthy, Thrifty Meals'

> *I work two jobs… I walk all day from 6:30 in the morning till about 10:30 at night…The only thing I sit down for is my breaks, when I eat lunch, when I eat and that is it. FG3*

Lack of time is often discussed as a barrier to meal planning. Two participants also discussed lack of physical space as a barrier to meal planning. When too many people are in one space, they do not have room to prepare meals at the same time, eat together, or have group discussions together. These stressful environments make it difficult for the primary caregiver to keep track of what is being consumed and what needs to be replenished.

Although only one participant discussed financial uncertainty as a barrier for planning meals, based on the financial concerns voiced by other participants, we believe this barrier may play into the lack of meal planning by other participants. We found that participants relied on many forms of resources to purchase food, such as income, food vouchers, alimony and child support. The latter two are not always received on time, thus budgets must be flexible. Even the change in receiving food stamps made one participant rethink meal planning:

> *I did for a while, but lately when we stopped getting our food stamps, it is like day to day now. It is just day to day, I will just look in the cupboard, this looks good, I will pull out the meat first, whatever looks good with the meat, I will pull out with it, the starch, the vegetables. But I don't plan anymore. P14*

We highlighted the lack of space and financial uncertainty as barriers to meal planning because they are specific to our target population and must be considered when developing applications to assist with meal planning. Participants who did not plan their meals were in different stages of change, thus addressing these barriers can help a large set of the target population. Even if participants do not plan their meals, everyone must obtain food with their own strategies.

Participants who planned their meals were more likely to search for bargains and buy bulk items for food purchasing strategies. These results bolster findings that people who plan their meals in advance have more control over the foods their families consume.

7.7.4 Summary

It is resonant with Maslow's Hierarchy of Needs [167] that caregivers need to address everyday survival needs before even thinking about developmental needs. At the crudest

level, the main priority is to feed the family. This section showed that the health promotion messages being conveyed by traditional means either do not resonate with the population, or are missing the crux of the problem. It then highlighted the challenges that are faced by this population when wanting to implement dietary changes. The challenges revolve around buying, preparing, and eating healthy meals:

- buying: budgeting, shopping
- preparing: from ingredients to meals, planning
- eating: introducing new food, substituting ingredients

When looking for information about healthy eating, participants were given generic advice from their healthcare providers and often found the same irrelevant or inappropriate advice online.

In addition to highlighting the challenges faced by this population, we also observed the strategies that are already being employed by some to make their money go further. Ideally the benefit of experience would be shared between community members, but as we shall see in the following section, issues of trust and isolation prevents the development and utilisation of such social capital.

7.8 Collaboration

Collaboration around behavioural change was limited in this population for a number of reasons. Structurally, the majority of participants were the sole adults in their household looking after multiple children. Several participants were new to the area and were yet to establish friendships; more still identified a lack of trust in people from the surrounding area. For those with established social networks, few ever discussed the issues raised during this study with their peers.

Those who had succeeded in making improvements to the dietary intake of their family all identified having at least one other member of their peer group who was similarly interested in health or had received formal support.

7.8.1 A Problem Shared: Isolation

Overall, health and healthy living were not topics that were openly discussed between friends or within families, despite being a concern for the majority of our participants. With the exception of those who were brought up with an awareness of healthy eating, and those who had been bereaved or affected by serious illness, it was something of a conversational taboo. Within P2's group of friends she is known as 'the healthy one.' When she was in the early stages of changing her eating habits her friends would make jokes about it or try and persuade her not to bother. Now she has established healthy eating practices it is not something that they comment on. Neither does she try and persuade her friends to change, speculating that, "If they wanted to know they would ask." When asked what could have made the transition easier she replied "having more people around me that wanted to make the change." Although she felt isolated within her group of friends with respect to her attitude towards health, she received support from formal outreach programmes. The remaining participants in maintenance reported sharing an interest in health with at least one other trusted person.

For others it was not a case of the topic coming up in conversation, rather there was nobody to have that conversation with. Many of our participants were new to the area when they were interviewed, not yet having had the chance to get to know other families in the area. Once settled in the area, issues of trust limited the possibility of establishing a social network:

> *I've been in bad situations with neighbours, that's why I say it's a safety issue with me now because I made bad choices in friends where I used to stay, and it was just – it was h-e-l-l. So, when I moved here, I said, "I'm going to change the friendliness, I'm going to change the talking to everybody in the neighbourhood, I'm just going to stick to myself and get my stuff done." P9*

Isolation was not necessarily perceived as a bad thing. Pride and independence, borne out of a history of self-reliance and self-sufficiency, meant that many of our participants were reluctant to ask for help from others. During P3's interview it was clear that she was extremely concerned about her youngest's picky eating, having run out of strategies to try and persuade him to eat. When asked if she had approached anyone for advice she replied that she would take care of it herself, like she always does. All participants reported some degree of isolation, be it due to external factors such as lack of social network, internal factors such as lack of trust, pride or self-efficacy, or a combination of both. There seemed to be some degree of correlation between the extent of isolation and stage of change. All of

the precontemplatives reported both internal and external isolating factors, while, as mentioned earlier, external isolation was only reported by one of the participants in maintenance.

7.8.2 Summary

Given the widespread concern about dietary the health of their children and dietary intake, it is surprising that many of the participants were contextually isolated. Any shared concerns that may have existed remained unspoken. The question of why participants chose not to verbalise their concerns within their peer groups cannot be answered definitively by the findings of this study. Independence obviously reduces the likelihood that an individual will seek help from others, but we suggest that the perception that health is something that other people 'do', and the helplessness that debilitated efforts to change (both perceived and actual), also restricts conversation: why talk about a problem to which there is no solution?

7.9 Discussion

We set out to investigate the issues and factors relating to health-related behaviour and behavioural change within low-income families, with a view to better understand the dynamics of behavioural change and scope for potential technological involvement. Essentially, what we have found is:

- a breakdown in communication within traditional health promotion medium
    - messages being conveyed by health professionals do not address the financial and strategic resources required to make behavioural change
    - social resources, such as the benefit of common interests and experience, are not being shared within the community
- a more complex representation of behavioural change that is currently accounted for in technological approaches to promoting health-related behavioural change
    - self-awareness and desire to change does not mean an individual is equipped to make changes.

We therefore suggest that there is scope for low-cost, accessible and appropriate technological interventions in this area, that address the existing gaps in communication and that empower people to take practical steps towards achieving goals that are within

their means. Of course we are not saying that one application will solve this population's problems. What we are saying is that if it is done well, it may play a role in lowering some of the existing barriers to behavioural change. It need not necessarily do the job on its own, but it can and should be considered as part of a wider community-based approach.

In contrast to the external barriers to improving dietary intake we suggest that the main barriers to increasing physical activity levels within low-income caregivers are a lack of (i) perceived value of physical activity, and (ii) low investment in self. We found a stark contrast between participants' attitudes towards their own physical activity and the physical activity of their children. Participants appreciated the value of physical activity as an intrinsic part of childhood, and encouraged physical play wherever possible. They were generally happy with their children's activity levels but expressed concern that their children's activity levels were greatly reduced during the winter months. Only five participants actively engaged in purposeful exercise; most of the remaining twelve acknowledged that they did not get enough physical activity but few explicitly expressed the desire or intention to become more active. Reasons given by the participants for reluctance to engage in physical activity were lack of time, exhaustion, and a disbelief that physical activity was of any benefit to them.

7.9.1 A Place for Technology?

There are some major obstacles that must be overcome before technology can play an integral role in the behavioural change of low-income families. For example, although mobile phone ownership was relatively high, most additional applications and services deployed outside the constraints of a user trial will incur costs to the families themselves through sending/receiving texts and data communication costs. Overlooking the very real problems of scalability and cross-platform compatibility, no matter how good the proposed application is, if the system is not subsidised or free then it is unlikely that these families will be able to afford them. Mobile p2p sharing of data and freeware for phones may well suit this application area and is worthy of further investigation. One important argument in favour of pursuing health promotion technologies for this population is that current approaches are simply not working. If current methods were working, the findings of Barton et al.'s study [24] would have been very different.

Access to technology was greater in this population than in the broader US population of low socioeconomic households. In 2005, only 36% had access to a personal computer and

27% had Internet access. However, 65% had cable television and 50% had mobile phone plans – these numbers are lower than what we found in the population we worked with, but it indicates the pervasiveness of these media. Indeed, mobile phone usage increased 27% in low socioeconomic populations in four years. Furthermore, after February 2009, low socioeconomic communities in the US will be able to access the Internet and associated web services by using digital cable set top boxes as a two-way gateway to the Internet, when all full-powered television stations switch to 100% digital broadcasting. New digital cable set top boxes are equipped to connect with ICT via short-range radio links (e.g., Bluetooth) or physical cables (e.g., gaming consoles, digital cameras).

All of the systems discussed in the related work section have assumed access to technology. In cases such as exergames, which require purpose-built interfaces, the economic challenge of accessibility is increased. This is not a problem unique to digital exercise when considering the cost of equipment and access to many recreational sports. In cases such as DDR, communal access (such as game arcades and bowling alleys) provides a greater degree of accessibility. For many, the spectacle involved in DDR is part of the appeal and exposure to the game. Indeed watching others is usually the first stage of engagement with the game [129]. For children, the instrumentation of communal spaces with pervasive technologies to encourage and inspire new forms of physical play, such as BodyBeats [260] and UbiPlay [168], would reduce financial demands on parents. Mueller et al's augmentation of traditional sports [179, 180] potentially offers similar benefits; that is of course presuming that the community as a whole has funds to invest in the required technology. Socioeconomic inequalities do not drive technical innovation, but in order to achieve widespread health benefits, it is suggested that wherever possible effort should be made to make health-driven exertion interfaces are as accessible as possible. For example, by using communal spaces or commodity devices such as mobile phones.

7.9.2 Motivation: addressing perceptual and practical barriers

In view of the dietary findings raised by this study, it would seem inappropriate to suggest technological strategies to increase motivation to make dietary changes. The predicament of forced precontemplation that the majority of caregivers were in with respect to dietary change leads us to suggest that technology should be designed for action, not persuasion. Or at the very least, that any attempt to increase an individual's motivation to change should be paired with an equal attempt to facilitate change. Such facilitative efforts are

discussed in the following section. For the moment we focus on the problem of motivating physical activity.

Given the perception that physical activity does not work, and furthermore that it is something that other people do, promoting the value of physical activity seems a sensible place to start when considering the development of technologies to encourage an increase in physical activity. As was highlighted earlier, current approaches to promoting physical activity with pervasive computing typically involves the automated monitoring of an individual's physical activity levels. While some persuasive technologies are explicitly aimed towards individuals are who already motivated [72], most leave the issue of whether or not the system is intended to prompt initial motivation to change unaddressed. If an individual is not already interested in physical activity, why would he or she choose to use such a system unless it provides an additional incentive e.g., game play? One potential benefit of ambient interfaces on commodity devices (such as Ubifit's glanceable interface [73]) is that they may promote gradual reflection on the information being conveyed by self-monitoring systems that are able to run in the background. However, unless augmented with an explanation of how physical activity impacts health, it is unlikely to motivate change for those unconvinced of its importance. We suggest that there are several benefits to augmenting sensed physical activity data. In addition to conveying the impact on health, the data could be augmented in such a way that it conveys alternative benefits that more readily resonates with the needs and values of this population e.g., saving time and money. For example, we can emphasise resource saving as a benefit of physical fitness: if it takes 20 minutes to walk to the store and fifteen minutes to drive, park, and walk from the parking lot to the store, we could emphasise that exercise only took 5 minutes that day (walking time – driving time) and how much they saved on petrol. Furthermore, by utilising an individual's own physical activity levels as a medium through which health messages are delivered, public health information becomes personal, thus promoting the cognitive process of self-referent encoding [206]: whereby information that is perceived to be related to the self is given priority.

The tendency for caregivers to place more importance on activities that benefit their children than on activities that benefit themselves, is a difficult problem to address technologically. One approach would be to harness the altruistic nature of the caregivers through the required participation in the exergames with their children and encourages them to participate in the activity 'for their children'. However, designers should be

sensitive to the danger of placing an already-pressured caregiver under even more stress. Additionally, feminists would argue that efforts should be made to motivate the caregiver to value and look after her own health:

> *Promoting exercise to women as benefiting others reinforces our patriarchal culture of women's needs being secondary to those of others. [181]*

While the effectiveness of integrating social influence into the design of physical activity promotion systems is yet to be conclusively proven, it would appear that one benefit is that they create a resource for interaction in and through which health behaviours can be discussed or reflected on (as was found with Shakra in Chapter 4). In making physical activity a collaborative activity and thus creating a resource for conversation, we suggest that socially oriented systems have the potential to help people overcome the obstructive perspective that physical activity is something that 'other' people do. Unfortunately we found that the majority of our participants were socially isolated, and so peer-based systems may face non-trivial barriers to adoption. In Section 7.9.4 we suggest strategies to overcome issues of trust and isolation, in an attempt to forge lines of communication between the as yet disjoint community members. If such strategies prove successful and are incorporated into the design of such systems, or in communities not so fragmented, peer-based systems would be more likely to be accepted.

The focus of the participants on physical play is in keeping with guidelines and suggested strategies for child-specific activity promotion. While generally happy with their children's activity levels during the summer, the winter months left some concerned. The apparent discrepancy between the prevalence of physical inactivity in Barton et al.'s [24] study and the attitudes of the caregivers with respect to their children's activity levels cannot be ignored. What is significant is that all of the caregivers were aware of the importance of physical and mental stimulation. Sensing technologies could easily be designed to provide objective verification of perceived activity levels. Here we focus on the application of technology to address an area of concern as identified by the study participants: seasonal inactivity.

It is in winter that exergames such as those discussed earlier may prove to be an effective substitute for traditional forms of physical play for those who do not have space in their homes and/or siblings to play with. In keeping with the participants' desire to provide mental and physical stimulation for their children, it is suggested that in addition to being

fun to play, the exergames should be framed within an educational and/or socially developmental narrative. A habitual dependency on games however should be avoided, as in the summer months some participants actively discourage the playing of console games. A seasonal hybrid that relocated to an organised outdoor activity programme in the spring may be an ambitious but potential solution.

7.9.3 Implementation: providing practical assistance of personal relevance

There is a broad scope for technical interventions in this area that are sensitive to the context of the population, both financially and culturally. We suggest approaching the problem from the perspective of the user as opposed to from the perspective of clinical guidelines**.**

The messages being conveyed by traditional means either do not resonate with the population, or are missing the crux of the problem. When looking for information about healthy eating, our participants were given generic advice from their healthcare providers and often found the same irrelevant or inappropriate advice online. Translating the content of the food pyramid into a meaningful resource for change is understandably an area of need. In addition to converting the pyramid components into balanced meals, the practicalities of buying, preparing, and introducing new foods should be considered within the tight socioeconomic constraints illustrated by our findings.

As we call for a realistic view of technology's potential for intervention, we also call for a similar view of behavioural change goals. Considering that our population currently have to prioritise between staple (for example, meat and bread) and luxury (for example, fruit) items, rather than pursuing a complete change of dietary intake systems should help users set realistic and incremental goals (recall P5 whose repeatedly enthusiastic efforts to make complete behavioural change were unsurprisingly short lived). For example the most basic goal could be to buy healthier equivalents of existing pre-packaged meals. The next goal could then be to substitute pre-packaged ingredients with fresh ingredients within the same meal, before suggesting alternative meals. Incremental goals will allow the users to step back when they feel that they have made all of the changes that they want to. Although this may go against traditional concepts of the success and failure of a system by not promoting complete behavioural change, we suggest that it is not our job to force new behaviours on people, but to assist them in making the changes they want to. Once goals have been

negotiated, the system should also assist them in taking practical steps towards achieving their goals. Our results showed that participants wanted to change their diets, but most did not know how to start. We need health promotion technology to be more than just digital leaflets, and go beyond raw information provision to support individuals to make changes to their lifestyles. What follows is a brief discussion of ways this need could be addressed, and suggests potentially fruitful avenues of research in this area.

In addition to being a more dynamic and adaptable medium, health messages can also be given a local face and a local voice through technology; something that is not often done through the traditional media of paper leaflets. Programmes that do work, such as WIC, are limited in scope by their labour-intensive nature. Cultural disparities between participants and those delivering health messages compounded the disparities between the message and the socioeconomic context of the participants' lifestyles. The stories and experiences of those who had succeeded in making changes could serve not only as inspiration but also as practical guides for those currently overwhelmed by the size and complexity of the task. For example, consider the subtle differences between:

- a generic webpage that suggests that planning meals in advance saves money (thus freeing up money for luxuries such as fruit) and one which contains a first hand account of how planning saves money

- a webpage listing strategies to introduce new foods to your child and a forum where caregivers exchange experiences and ideas

In an ideal world the benefit of experience would be passed between family and community members, but we have found that the transient nature of the housing project and lack of trust in neighbours means that the benefit of experience does not disseminate throughout the community. The EatWell System [116] provides a good example of how computer mediated social capital can contribute to this problem space, allowing community members to "record audio memories of how they have tried to eat healthily and share them with others."

7.9.4 Collaboration: breaking down barriers

The sharing or provision of information is just one form of social support that is widely acknowledged to be a resource for behavioural change and an indicator for health [30]. It

follows therefore, that those with low levels of support or who attempt behavioural change alone are at a disadvantage in relation to those who have the support of others. Indeed, all of the participants who had successfully implemented dietary changes reported having formal or informal sources of support. Given the reported lack of interaction between community members, technology could prove to be instrumental in the establishment of lines of communication. Anonymous and asynchronous communication appear to be promising technical strategies to overcoming the current socially obstructive issues of trust and lack of time. Traditionally acceptable topics of conversation (e.g., recipes) could form basic foundations upon which to build. Once established, users could manage their own level of disclosure and introduce topics of concern, thus slowly breaking isolation barriers.

It is conceivable of course, as we found with a few of our participants, that not everybody wants to seek help from others. In such cases it is possible that they would avoid using sociocentric health applications. Alternatively, their sense of pride and independence may extend to preventing them seeking help from technology at all. Either way, at least the resources (both social and technological) would be there for them to use if and when they wanted to.

7.10 Conclusion

This chapter presented our study of health and everyday behavioural change as experienced by the primary caregivers of young low-income families. It presented an exploration of the broader socioeconomic context of health-related behavioural change for one population not traditionally considered in the design of pervasive health technologies. We found that, through their experiences of living with ill health, the majority of the participants were already aware of the healthy and unhealthy aspects of their current dietary habits, and already wanted to make a change. What restricted their attempts to change was the lack of necessary financial, strategic and social resources. Attitudes towards physical activity were divided, in that participants appreciated the developmental value of physical play for their children, but tended to disregard it as unnecessary and ineffective for themselves.

This chapter argued that health-related behavioural change is more than a simple matter of motivation, and the outcome of such an argument was the identification of alternative avenues of research for technology aiming to promote positive changes to health-related behaviour. In addition to highlighting the limitations of relying on behavioural awareness

as a motivation for change, the experiences of the participants were illustrative of, and go some way to explain, the limitations of information provision as a resource for behavioural change (as discussed in Chapter 2). Relating to the insights gained into the inadequacy of existing information provision, the importance of cultural relevance was further emphasised. In view of these observations, our discussion pointed to two recommendations to increase the *relevance* of technological innovations:

- Applications need to be more than just digital leaflets, and go beyond raw information provision to support individuals to make changes to their lifestyles
- Interfaces should provide health messages with a local face and a local voice

In contrast to the traditional notions of the collectivist culture of Latino and African American populations, social isolation was observed arising from the transient nature of the neighbourhood and lack of trust between community members. A lack of willingness or opportunity to engage in conversations with peers about health concerns and health-related behaviour subsequently led to contextual isolation. In most everyday behavioural change systems, the availability of an interested social network is presupposed. This chapter argued that technology might be a suitable medium through which to foster *social capital*:

- Anonymous and asynchronous communication should be employed to overcome the current socially obstructive issues of trust and lack of time
- Socially oriented systems have the potential to help people overcome the obstructive perspective that health and health-related behaviours are things that 'other' people do

With respect to designing technology to promote *dietary* behavioural change for this population, this chapter argued that technology should be designed for action, not persuasion. Resonating with the earlier recommendations relating to relevance, two further suggestions were offered:

- Systems should help users set realistic and incremental goals, rather than pursuing a complete change of dietary intake
- System should assist the user in taking practical steps towards achieving their goals once goals have been negotiated

In contrast to the external constraints that limited dietary behavioural change, the chapter argued that barriers to *physical activity* of a practical and perceptual nature. Two guidelines are suggested in response to the caregiver's reluctance to engage in physical activity:

- Augment sensed data to convey physical and alternative values of physical activity
- Be sensitive to the danger of placing an already-pressured caregiver under even more stress when harnessing the altruistic nature of the caregivers

In response to the concerns voiced by many of the participants with respect to their children's reduced physical activity levels during winter, and their attitudes towards the mental, physical and social benefits of physical play, this chapter argued that affordable mobile and exergame technology can potentially contribute to this problem space. We made two *exergame* recommendations:

- Combine exergame and mobile gaming technology to provide weather-appropriate opportunities for physical play
- Exergames should be framed within an educational and/or socially developmental narrative

In contrast to the democratisation of weight management resources that was observed in the previous chapter, in this chapter a lack of resources delimited or prohibited behavioural change efforts. Perhaps the most significant contribution of this study is the sensitisation to external constraints that it provides, which first led us to question the appropriateness of persuasive technology. This chapter argued that instead of persuading behavioural change technology should be designed to assist and facilitate the change that an individual wants and is able to make. It argued for technology to approach the problem from the perspective of the user as opposed to the perspective of clinical guidelines.

8 Cardiac Rehabilitation

A cardiac rehabilitation programme offers a relatively controlled context in which to study everyday behavioural change. All rehabilitation participants have a diagnosed cardiac condition and attend the structured clinical programme in the weeks following a cardiac event. Occurring over a finite period of weeks, the rehabilitation programme offers an incentive and focus that may not necessarily exist in 'everyday life'. By investigating this domain we sought to gain an understanding of the potential for technological support within a population with a vested interest in behavioural change.

8.1 Introduction

The inclusion of a clinical domain may seem at odds with a thesis specifically investigating the issues and factors surrounding everyday behavioural change. However, although participants are enrolled on a clinical programme, we remain focussed on the aspects of behavioural change outside of the clinical environment and the interplay between the cardiac rehabilitation programme and everyday life. In this respect any distinction between clinical and everyday change is artificial, as has already been pointed out, "most of the dynamics of behaviour change take place in patients' private and work settings." [246]

Although Obesity is the most commonly cited motivation for the everyday behavioural change technology that was reviewed in Chapter 3, Coronary Heart Disease (CHD) is also worthy of consideration:

> *CHD is the most common cause of premature death in the UK: 22% of premature deaths in men and 12% of premature deaths in women are from CHD.*
> *Deaths from CHD are highest in Scotland and the North of England, lowest in the South of England and intermediate in Wales and Northern Ireland. The premature death rate for CHD for men living in the Scotland is almost 70% higher than in the South West of England and around 80% higher for women. [46]*

This aims of this study were to explore the issues and factors surrounding everyday behavioural change and the sharing of rehabilitation-specific data, as perceived by rehabilitation participants, and identify ways in which technology can be used to support appropriate peer involvement in cardiac rehabilitation.

The remainder of this chapter reads as follows. To complement the existing literature reviews in Chapters 2 and 3, we start by providing an overview of the literature surrounding social support and cardiology. In Section 8.3 we present an overview of the study location. As was mentioned in Chapter 5, we originally intended to use a technology probe in this study but after the pilot-study we decided to withdraw the technology probe from the main study and continue using interviews only. Section 8.4 presents the technology probe and the findings of the pilot study, and discusses our decision to withdraw it. For details of the methodological approach employed in the main study, please refer to Chapter 5. In Section 8.5 we present the main study participants by age, gender, marital and cardiac status, and current use of technology. As was explained in Chapter 5.5, we have chosen to structure the findings of each of the studies around three topics: motivation, implementation and collaboration.

8.2 Background

The relationship between social support and health that has been discussed throughout this thesis is emphasised within the cardiac literature. Social support is positively correlated with cardiac outcomes including recovery from myocardial infarction (MI)[27] recovery [13], participation in cardiac rehabilitation programmes [218], and health-related behavioural

[27] Myocardiac Infarction: the clinical term for a heart attack.

change [100]. It can be so strongly linked that the lack of a social support network (social isolation) has been deemed to be a risk factor for both the development of coronary heart disease (CHD[28]) and prognosis of established CHD [52, 233] equivalent to "classic" risk factors, such as high cholesterol and smoking [176].

Most work in this area explores the issues faced by individuals and their immediate family (typically spouses), namely tensions between couples, effectiveness of support efforts, and the information needs of the spouse. It is usual for an individual to experience depressive symptoms and feelings of uncertainty after a cardiac event [255], and a loss of confidence is also commonly experienced by spouses [170, 255]. The main source of tension appears to be in the negotiation of role resumption, when the individual is trying to regain independence [15] or the spouse or family member is being overprotective [70, 255]. Spouses have expressed feelings of exclusion because they felt that their wife or husband had withheld information from them [170], and because of the relatively little information or support given to spouses or family members by the health professionals during the rehabilitation period [15, 170].

Spouses have changing information and support needs as time progresses: through diagnosis, to hospitalisation and homecoming [84] . In addition to alleviating the emotional stress experienced by spouses, "assisting spouses will subsequently improve patient's recovery and facilitate lifestyle changes" [84]. Areas of need appear to be addressing misconceptions about the causes of coronary heart disease [140] and the value of behavioural change [128], and conveying the difference of between social support and social control [100]:

> *Health-related support is conceptualized as spouses' assistance to and affirmation of patients' own efforts to initiate and sustain prescribed behavior changes. In contrast, health-related control is conceptualized as spouses' efforts to induce patients to initiate or sustain prescribed health behavior changes when they have been unable or unwilling to do so on their own.*

While social support is generally acknowledged as having a positive relation to health, the relation between social control and health is much more ambiguous [100]. In Franks et al's [100] exploration of spousal provision of support and control to cardiac rehabilitation participants, spousal support was associated with healthy lifestyle behaviour in the short term (immediately after cardiac rehabilitation) and predicted positive mental health in the

[28] Coronary heart disease: narrowing of the heart's small blood vessels

long term (six month follow up). In contrast, spousal control was not associated with health behaviours or mental health in the short term, but predicted decreases in health behaviour and mental health at six months. Regardless of intention, spousal support efforts that are delivered in a controlling manner may negate any potential beneficial effect. Developing a spouse's skills in support provision may therefore contribute to the individual's behavioural and mental health.

While it is important that the problems faced by individuals and their families are addressed, it was found that a statistically insignificant difference in mortality rates exists between those with moderate and high levels of social support [13]. In contrast, the same study found that those with the lowest levels of social support experience "2- to 3-fold excess [CVD[29]] mortality", suggesting that efforts should be concentrated on those with no existing support networks. Unfortunately, there is relatively little research into how to ameliorate the problem of social isolation.

While there are social support structures (both health professional- and peer-based) in traditional cardiac rehabilitation programmes in hospital and community settings, the primary focus remains on physiological recovery through cardiovascular exercise, rather than psychosocial interventions. Patient-based support groups appear to be promising venues for non-traditional support provision, Arthur et al [14] developed "a community-based communication and psycho-educational support group for women with heart disease" in response to the outstanding needs of female cardiac patients left unaddressed by traditional rehabilitation (for further discussions of gender-based needs and experiences please refer to [146, 165]). Volunteers composed of former cardiac patients or spouses of former cardiac patients, who provide practical and emotional support to current patients and their families, benefiting the current and former patients who are involved, run the Duke Heart Cancer Patient Support Programme [233]. In addition, patient led services are also a relatively low cost intervention [233]; they, do, however rely on a corpus of motivated individuals with free time to participate.

Reflecting the focus of traditional cardiac rehabilitation, technological innovations in this area are grouped around web-based delivery of rehabilitation programmes [147, 226, 261] and physiological monitoring [16, 33, 106, 137, 234]. The issue of Internet access is especially pertinent to the consideration of web-based cardiac rehabilitation considering

[29] Cardiovascular diseases: angina, stroke. congestive heart failure, heart attack

the prevalence of heart disease in the elderly and populations of low-socioeconomic status. However, it is considered to be a promising method of delivery to cardiac patients in remote rural communities with no access to hospital-based rehabilitation and for populations who under subscribe to existing programmes (for example, women [226]). Unlike the conflicting results with respect to weight-related interventions that was discussed in Chapter 6.2, the few cardiac web interventions that exist have produced relatively positive outcomes [147]. In a recent pilot evaluation of a "virtual" cardiac rehabilitation programme (vCRP) against a traditional cardiac rehabilitation programme (CRP), the vCRP group experienced clinically significant improvements in risk factors (blood lipids, cholesterol levels, weekly physical activity) and exercise capacity while the control group did not [261]. The design of the vCRP is described briefly below:

> *The vCRP was designed to mimic a standard hospital-based CRP (which range from 12–16 weeks' duration) as much as possible and included on-line intake forms (medical, risk factor, and lifestyle forms), scheduled one-on-one chat sessions with the programme nurse case manager, exercise specialist, and dietician (three times each during the 12 weeks), weekly education sessions in the form of slide presentations with multiple choice questions, data capture for the exercise stress test and blood test results, progress notes (for health professionals), and monthly ask-an- expert group chat sessions. [261]*

A larger clinical trial of a similar system yielded somewhat confusing results. Although no statistically significant difference was observed between the web and control group with respect to behavioural or physiological outcomes (apart from weight loss which was greater in the web group), the web group participants experienced significantly less cardiac-related emergency visits and hospitalisations during the six month trial [226]. The authors speculate:

> *These small changes across risk factors, combined with the statistically significant changes in weight, may have reached clinical significance, potentially accounting for the disparity in the rate of clinical events between the two groups. Other reasons why the [web group] participants had a lower event rate may be less obvious and more difficult to measure.*

Self-monitoring is used as a resource in cardiac rehabilitation to measure effort and progress, both in hospital and at home. Although each cardiac programme differs, they typically involve a range of self monitoring approaches, varying in technical complexity ranging from continuous ECG monitoring to self-assessment of perceived level of exertion using Borg's Rate of Perceived Exertion Scale [41]. It has been found that long term use of continuous ECG monitoring can cause reduced self-efficacy for independent exercise

when compared to an equivalent programme that gradually weaned patients off ECG monitoring [56]. In addition to the risk of unnecessary dependency on technology, the benefit of using technology over manual methods is still to be established in patients who are not considered to be high risk. Over the course of one month, home rehabilitation participants increased their exercise capacity and were able to regulate their own physical exertion at comparable rates regardless of whether they were using self assessment (Borg scale) or technological measurements [132]. In the long term, there is evidence to suggest that those who continue to self-monitor physical activity and physiological measures maintain change for longer than those who do not [12, 134]; both studies employed technology-facilitated monitoring with no manual comparison.

Remote physiological monitoring technologies for cardiac patients are being offered as potential solutions to the problems of service access, overstretched clinical resources: hospital beds, hospital-based rehabilitation and budgets. A commonly proposed architecture involves traditional monitoring technologies such as blood pressure and heart rate monitors, and more recently accelerometers and pedometers, with Bluetooth capabilities to transmit data to a smart phone that acts as a base station [16, 33, 106, 137, 234]. For a comprehensive review of current approaches to remote monitoring and the outstanding challenges to be addressed before remote monitoring becomes a clinical reality, please refer to [148].

8.2.1 Summary

Social support is a strong contributing factor to the positive outcome of recovery, cardiac rehabilitation, subsequent prognosis and prevention. Much work has been done to explore the issues faced by spouses in the time after their partner's cardiac event. The outcome of the work has been a call for greater involvement of spouses in the rehabilitation process and greater provision of spouse-specific information and support by health care professionals. Interestingly, the issue of how to maintain patient confidentiality while increasing spousal involvement has so far been not been raised, and there is little work establishing the attitudes of cardiac participants with respect to increasing spousal involvement in what is currently their rehabilitation process. Another gap in the literature appears to be a lack of work investigating the provision of social support to socially isolated individuals, those who stand to benefit most from improved support structures.

The bulk of technological work being done in this area addresses the provision of cardiac rehabilitation programmes through web interventions and physiological monitoring. The benefits of technological over manual self-monitoring in populations that are not considered to be high risk are yet to be established, while the promising clinical outcomes of cardiac web interventions are accompanied by similarly impressive technical acceptance. For example, all of the participants responded "unanimously positively" to the vCRP [261]. Technical literacy was not identified as an inclusion criterion for either of the web interventions discussed.

The issue of technical literacy and access appears to be something of an 'elephant in the corner' that came to be of particular relevance to this study. We initially set out to investigate peer-involvement in cardiac rehabilitation through the deployment of a purpose built technology probe, Collabohab. During a two-month long pilot study this proved to be a naive approach to a problem space quite unlike those that had been studied before. Essentially, rejection of the technology and reluctance to involve peers in the study led us to rethink our methodological approach and continue the study without the probe. To avoid elephant-in-the-corner-syndrome details of the pilot study are presented in Section 8.4 alongside details of the design and implementation of Collabohab.

8.3 The Rehabilitation Programme

The Greater Glasgow and Clyde NHS Citywide Cardiac Rehabilitation Service (CCRS) runs a 10-week cardiac rehabilitation programme that is open to all individuals who have recently undergone cardiac surgery or have suffered a cardiac event. Those who accept a place on the rehabilitation programme attend a preliminary session where baseline observations are made, tailored physiological and behavioural targets are determined, and a programme is devised. Physiological risk factors that are considered include blood pressure, weight and cholesterol. Behavioural risk factors can include physical inactivity, smoking, diet, and alcohol intake. Over the course of the 10-week programme, participants are invited to attend weekly anaerobic or aerobic exercise classes (as determined by the rehab physiotherapist) and health and lifestyle educational sessions. At intermediate points during the rehabilitation programme a rehabilitation nurse formally reviews their behavioural and physiological progress. The involvement of friends and family in an individual's rehabilitation programme is actively encouraged by the CCRS but at present there are no formal mechanisms through which such involvement is facilitated. Upon completion of the 10-week programme, participants are given the opportunity to continue

attending exercise classes at local community centres. A very brief overview of the four phases of treatment offered by the CCRS is presented in Table 8-1.

Phase	Description
1	Acute intervention period (inpatient)
2	Home recovery period (discharged)
3	Supervised rehabilitation programme (outpatient)
4	Ongoing exercise provision (community)

Table 8-1: Four Phases of Greater Glasgow and Clyde NHS Citywide Cardiac Rehabilitation Service

8.4 Technology Probe Design and Pilot-Study

For this study the author designed and developed a technology probe[30], Collabohab, a multimedia collaborative rehabilitation journal (presented in following section). While recruiting for the pilot study it became apparent that deploying a lightweight social networking application into this population was not appropriate. Firstly, access to technology was particularly low; in one of the rehab classes only 3 of 18 patients had access to the Internet. Even those with access to the Internet were not necessarily comfortable enough with technology to participate. Those who did participate did not see a benefit in changing from pencil and paper to computer-based monitoring. Secondly, those who did participate chose not to involve friends or family. Reasons for not involving peers included pride, independence and not wanting to be a burden. The findings of the pilot study are discussed further in Section 8.4.2.

8.4.1 The Design Process

The purpose of Collabohab was to create a medium through which rehabilitation-related data could be captured and explicitly shared with, or hidden from, peers. Of particular interest are patterns of interaction that exist between rehab participants and specific members of their friends and family, followed by interaction between fellow rehabilitation participants. If identifiable patterns did emerge, we wanted to find out if they persist throughout the rehabilitation process or whether they change over time.

The design process can be divided into four components:

- assessing the population's access to and familiarity with technology

[30] Technology probes are introduced as a HCI research method in Chapter 5.2.4

- determining functional requirements
- study design (logging and analysis)
- user interface design

As already mentioned, our technical aspirations for the probe were not elaborate and so while we were aware that the probe would be technically feasible we had to establish whether or not it was sociotechnically feasible. By assessing the target population's access to and familiarity with technology, we hoped to gauge what forms of technology should be used, and how realistic it would be to propose such a probe for use. In determining the functional requirements of the probe, we sought to identify what type of information is currently monitored during rehabilitation and therefore potentially shared by our probe. Additionally, the logging requirements of the probe were decided. In consideration of the feasibility and requirements of the proposed probe, the user interface was then designed.

8.4.1.1 Sociotechnically Feasible?

In order to establish the demographic of the cardiac rehabilitation program a questionnaire was devised and distributed in the Glasgow Royal Infirmary rehab classes. 27 questionnaires were returned having been fully completed. 75% of the respondents were male and the predominant age group was the 70-79 year olds, followed by the 60's (8/27), 50's (4/27) and 40's (4/27). (2/27) were over 80 years old.

Computer Access and Usage: Only 12 of the respondents have access to a computer at home. Computer access by age is fairly evenly spread over the age groups apart from the over 80s, neither of whom had access. The under 50s were the only age group to report using the computer daily, the other age groups tended to use the computer a few times a week or a few times a month (see Figure 8-1). The most commonly used applications were email and web (see Figure 8-2).

Mobile Phone Ownership and Usage: Many more of the 27 respondents owned a mobile phone (19) than had access to a computer, and distribution of ownership of age was similar to that of computers. Again neither of the 80+ respondents owned a mobile phone, but 6 of the 10 70-79 year olds did. Of the individuals who owned a mobile phone, over 50% used it daily. (~30%) used it a few times a week with the remaining (~20%) using it a few times a month. Somewhat surprisingly, of the 19 individuals who had a phone, only 6 used it to

make calls (see Figure 8-3). The older participants tended to use it to receive calls and texts rather than make them.

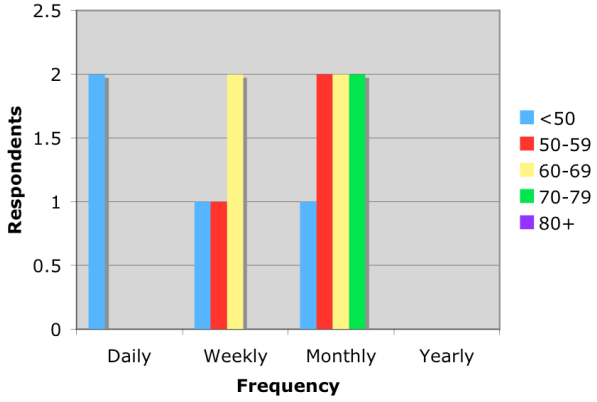


Figure 8-1: Frequency of Computer Usage

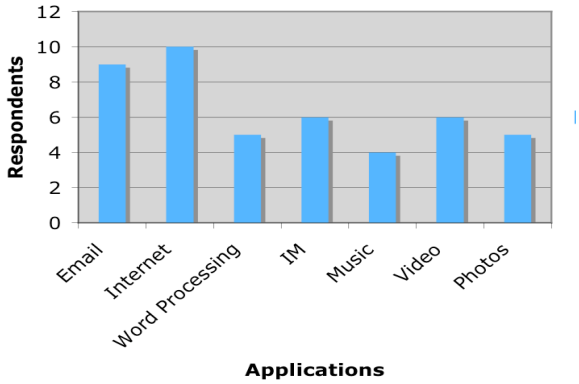


Figure 8-2: Applications Used

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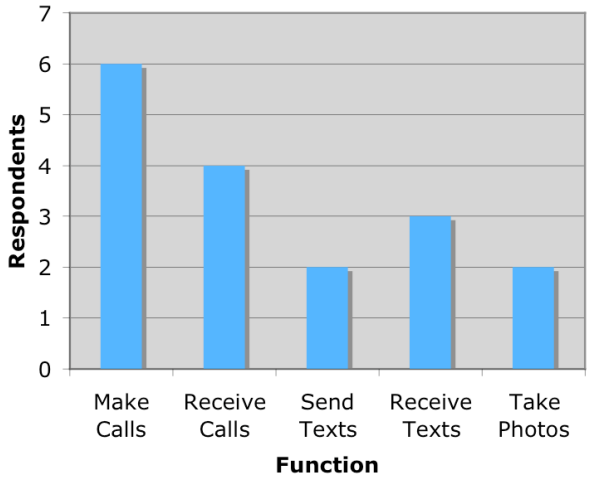

Figure 8-3: Mobile Phone Usage

As was expected, the CR population represented in this study had both moderate levels of access to and moderate levels of familiarity with PCs and mobile phones. While only 44.4% had access to computers at home, others did have access elsewhere. A large majority of those with access were able to use the Internet and email. This would suggest that a simple web interface would be feasible for those who had existing access to computers. On the other hand, although many more respondents had mobile phones, relatively few of them made calls (1/3) or texts (1/10). It was therefore imperative that any

phone interface should be as simple as possible. In view of these findings, it was thought that there was scope for technological interventions in the area.

8.4.1.2 Functional Requirements

Reflecting the overall aims of the study, the primary requirements of the probe were to allow the recording and sharing of rehabilitation data; both progress-related and experiential data. Meetings were held with senior nurses and physiotherapists in the CCRS to elicit what sort of data is currently monitored during the program. It was felt to be important that the probe reflect current practices and not force undue focus on one particular aspect of an individual's rehabilitation. During the meetings the staff produced a coronary heart disease (CHD) card[31] that is given to the rehabilitation participants to monitor their behavioural (physical activity, smoking, diet and alcohol intake) and physiological risk factors (cholesterol, blood pressure, pulse and weight).

It was agreed that the probe should allow the patient to record the same data, with the one amendment that both positive and negative behavioural data be allowed for e.g. instead of the patient only record how many drinks/cigarettes he or she did have, there should also be a way of recording how many he/she chose not to have.

Experiential data could be captured in the form of photographic, audio, video, or text memoirs. Multiple formats would not only promote a rich set of data, but would also allow a patient who was not so comfortable with one of the formats to chose from the alternatives.

All of the data entered by one patient should be collated into a rehabilitation journal. To promote interaction between peers and the patient, the peers should be able to view and leave comments on their patient's journal to which the patient can respond.

A critical requirement of a technology probe is that is able to log information about its own use in order to allow retrospective analysis of how it was used and by whom. While logging data input is unproblematic, the need to log 'who looks at what' can cause tensions between creating a probe and creating a system which is as 'user friendly' as possible. In order to log everything that a user looked at it would be necessary to force the user to

[31] During the pilot-study it emerged that the CHD cards were not actually used by the staff or patients 'on the ground'.

select an item on the screen before that piece of data was made visible: making even retrieving one piece of data laborious.

To find out exactly what information was accessed on each visit to the journal, the interface would have to present a menu of options and only one option could be selected at any one time. For each data item there can be comments from other users of the system and they themselves would have to be selected and presented individually. It is suggested that while logging to this granularity captures the most information about usage, it does so at a risk of making the system so complex or unappealing to use that it could discourage participants from using the system. An alternative approach would be to reduce the granularity of logging to allow a more 'user friendly' system and coherent view of the data. The poorer granularity of logging can be compensated for by analysing the time spent on the main page in relation to the content of the page e.g. looking at time spent on pages with no memoirs against time spent on pages with photos etc.

8.4.1.3 User Interface Design

Designing for a mainly elderly user demographic who is familiar with but not necessarily confident using technology presents challenges that are best overcome through participatory design. Unfortunately access to patients is forbidden without ethical approval. Because the design and development of Collabohab had to start ahead of gaining ethical approval (due to time restrictions) participatory design was not an option. Elderly members of a local bowling club gave informal feedback to early designs.

The major challenge lies with the development of the mobile phone interface. Unlike Shakra, which required minimal user input, the primary function of the mobile phone in Collabohab is to be a data capture tool. The user must navigate menus, input numerical/textual data and control the camera and audio recorder. The traditional menu in the smartphone interface was found to be unsuitable during the informal feedback session, as the text was considered too small. Instead menus were better received when illustrated on the main screen of the interface. Not all who used the menu were familiar with the joystick on the phone and preferred to select menu items numerically, although those with experience of computers and phones with joysticks preferred to select menu items manually. This combination of numeric and scrollable menu item requirements, alongside the need for large text precluded the keypad menu layout in favour of the more traditional list layout. During data entry that involved moving between text boxes e.g. when entering

systolic and diastolic blood pressure, not everybody noticed the cursor flashing in the active text box and so additional highlighting of the cursor and active text box was requested.

In order to take photographs, video and audio recordings from the application it is necessary to use the phone's camera and audio API. While the generated audio interface is relatively simple to use, the camera has a very poor interface: with no labelled 'capture' menu item to take the picture (the user has to depress the joystick), and no instructions to exit after the picture is taken (the user has to press the 'back' menu item). Unfortunately, no solution to this problem has been found and so it must be accepted as a limitation of the system implementation.

8.4.1.4 Collabohab

The rehab participant using the phone can manually enter behavioural and physiological data. Photographic, audio and video 'memoirs' can be captured and uploaded from the phone to the journal. Figure 8-4 shows the screenshots of the phone interface encountered when entering a blood pressure recording.

Figure 8-4: Collabohab Phone Interface- Entering Blood Pressure

A basic temporal representation of the participants' data is accessible on the phone (see Figure 8-5), and a web page provides full visualisation of their journal entries and allows them to annotate their data. Only rehab participants will be given a phone; using a web browser, rehabilitation professionals and peers and will be able to view the journal of the participant they know, for whom they can also leave messages. Rehabilitation participants

will also be able to view and contribute to the journals of each other. The health professional's view of a patient's journal can be seen in Figure 8-6.

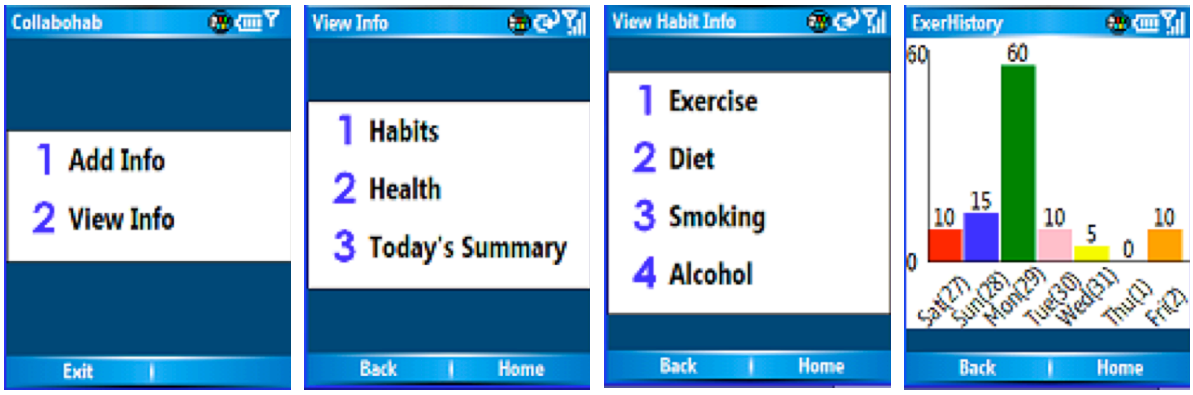

Figure 8-5: Collabohab Phone Interface- Viewing Exercise Levels

Figure 8-6: Collabohab Web Interface- A Health Professional's View of Julie's Journal

During the COREC review process, the committee were concerned by the privacy issues raised by automatically sharing the rehab participants' data. This original feature of the probe was intentionally provocative to stimulate discussion about what is and what is not acceptable to share. Privacy is a contentious issue with regards to both health and ubicomp systems. Recent research has shown that asking individuals about their privacy preferences

rarely generates responses that match their actual behaviour [143]. In order to address this issue, privacy preferences are entered with each data capture e.g. when a participant takes a photo or enters their BP, a permissions list of peers is presented which the participant can edit as they wish. By default all of the peers are able to view the data; the participant can change the individual permissions by selecting/deselecting the peer (either numerically or manually). Although this method risks being cumbersome, it encourages fluidity of data sharing rather than a judgement being made at the beginning of the trial that remains by default. On the web interface the participant can view and edit the visibility permissions of each memoir/physiological/behavioural entry (see Figure 8-7).

Figure 8-7: Collabohab Phone and Web Interface- Setting Privacy Levels

8.4.2 The Pilot-Study

The pilot study ran for 8 weeks between 22nd October 2007 and 17th December 2007. A survey of access to technology within the programme (carried out earlier that year) indicated 45% home access to the Internet and 70% owned a mobile phone. We hoped to recruit four participants, but due to recruitment difficulties explained in the following section, could only recruit three (one of whom had to drop out after being admitted to hospital for an unrelated condition). An overview of the two participants who completed the study is given below.

P1 is a 71-year–old male who was enrolled on the programme following cardiac surgery. He had no family history of heart disease, but was being treated for high blood pressure and high cholesterol prior to his surgery. He attributed a high adrenalin lifestyle, lack of exercise and diet that was 'not as good as it should be' as possible contributing factors. He is a semi-retired media executive who lives with his wife. They have two sons and one

daughter who live in various parts of the UK. Although he was comfortable using a mobile phone and basic operations using a computer, he described himself as 'not particularly technically able.'

P2 is a 50-year–old male who was attending the programme for the second time after his second MI in two years. He had no behavioural risk factors, but had been pharmaceutically treated for hypertension. He lives with his partner and has no children. He has a sister and two nephews who he sees once a month. He visits his housebound mother approximately once a fortnight, who he describes as semi-dependent on him. No friends were mentioned during the interview other than his colleagues, who are all clinicians (as is his partner). He works as a consultant pathologist and is comfortable with technology (describes himself as 'pretty Internet savvy').

The remainder of this section discusses two aspects of the study that can broadly be categorised as social and technological obstacles to system adoption. Firstly, access to technology and lack of perceived need; secondly, reluctance to involve peers in rehabilitation.

8.4.2.1 Technological Obstacles

Lack of access to the Internet was the single biggest barrier to recruiting pilot-study participants. Despite the findings of the earlier survey, access rates where found to be much less than 45% while recruiting for the pilot. In one of the rehabilitation classes only 3 out of 18 patients had access to the Internet. However, access did not guarantee participation. Many prospective participants explained that although they had access to the Internet and were comfortable with email or browsing the web, they were not confident enough to try anything new. The conflicting findings from the pre-study survey and the pilot-study with regards to Internet access suggest we may have been 'luckier' if we had recruited from a different cohort of rehabilitation participants. However, the changing profile of the rehabilitation programme's demographic is central to the wider problem of developing pervasive health technology.

The participants of the pilot-study raised an additional challenge for researchers in this area. Both of our participants already had established self-monitoring practices, and did not necessarily see benefit in changing from pencil and paper to computer-based monitoring. The reluctance to use technology "for technology's sake" has since been expressed by

participants in the main study, and will be revisited in Section 8.7.3. Although a technology probe is intended to be a tool through which research is carried out rather than a potential intervention, when the study involves populations other than 'early adopters' [177] even a probe must be of value to them, as perceived so by the population itself.

8.4.2.2 Social Obstacles

We are primarily interested in exploring the interactions between fellow rehabilitation participants and between rehabilitation participants and their friends and family. Therefore, we had initially hoped to recruit all pilot participants from the same rehabilitation group (a condition of the ethical approval was that the boundaries between rehab groups would be maintained). Unfortunately, due to the recruitment difficulties described above, we had to extend our recruitment efforts to pool from three rehabilitation groups. The participants were members of different groups and so we lost the opportunity to explore that aspect of interaction during this pilot study.

This loss was compounded when it transpired that none of our participants wanted to involve their friends and family in the study. When asked why not, P2 simply stated "I didn't think that there would be much in it for them", but then continued to explain that the type of information being entered into the system "wasn't something that I thought they should be particularly involved in." It emerged during the interview that although he was open with his family and colleagues about his condition, the recovery process was essentially a private one. When talking about rehabilitation he stated:

> *I have regarded it as my class and you know, it's me against me, working out what my body can and can't do. I have found no limits to what my body can do and that is great.*

Apart from this personal view of rehabilitation and recovery, the well-documented tendency of friends and family to fuss over an individual after a cardiac event may well be a barrier to the invited involvement of others in rehabilitation:

> *My observation has generally been that folk around me want to mollycoddle me… you know, so if I was to make any kind of comment at all it is that folk are forever saying 'don't lift that', 'don't do this'. 'don't do that', and I am arguing with them saying…'no actually I can lift this… I can do this', and there is nothing stopping me going up a ladder to take the curtains down. You know, we had a fight about that last night. We are having the house decorated at the moment and you know… who is going to take the curtains down? I am perfectly able to do that now… I know what I am doing. So maybe there are a*

> *few things that I could have entered [into the web memoir]… about observations.*

P1's reasoning for not wanting his friends and family echoed that of P2's: "well it doesn't really affect them anyway, I mean I am the only person… basically affected and so it doesn't affect them". A more subtle explanation of his reluctance to involve friends and family can be found in his efforts to avoid worrying his family "unnecessarily". On various occasions he spoke of "playing down'" the scope of his operation because worrying the family would do no good. With respect to sharing aspects of his rehabilitation with his family he said that:

> *I don't think that it is a question of not sharing, but I think that you have got to share the whole context or not. And you know if I have got a twinge or worry about something then I wouldn't share it unless I knew it was part of a pattern which I knew needed to be communicated to them. I don't think that it is kind to pass on a worry to someone which they may think it is bigger than it actually is.*

Similarly, with P2 it became apparent that, rather than P2 being the sole recipient of social support, P2 and his partner were mutually supportive of each other. As much as P2's partner supported P2 by encouraging (and sometimes discouraging) him from doing particular activities, P2 also supported his partner during the phase of coming to terms with what had happened. Although it is only P2 who had the MI, he talks of both he and his partner taking stock of what is important in life and "being a bit more enthusiastic about doing things now rather than later". While P1 also spoke of the reprioritisation that occurs after a cardiac event, he did not talk about this as a shared experience with his wife and family. Indeed, it does not seem that his condition had been talked about much with his immediate family, as when asked how his wife dealt with his upcoming operation he responded "fairly calmly I think", and of his children "I don't actually know if they knew what was involved." Just having a loving family there was enough for P1; even though he had not needed them, he knew they were there if he did.

Both participants had families that were not necessarily actively involved in their rehabilitation but were nevertheless sources of anticipated support. In these cases, both participants were happy with the levels of support that they received and did not want to increase the levels of involvement: partly due to the independent ownership of the rehabilitation that they both expressed and partly out of care for the families, not wanting to worry or burden them.

8.4.3 Decision to Withdraw Collabohab

Collabohab was designed as a probe to reveal information disclosure practices throughout the course of the rehab program between friends and family members, fellow rehabilitation peers, and rehabilitation staff. Unfortunately, the probe itself proved to be a significant barrier to recruitment, those who were recruited didn't have the opportunity to interact with peers through it, and chose not to involve friends or family members. In this sense the probe did not serve its purpose; nothing related to the initial objectives of the study has been learnt from its use. The main findings of this study were generated by the rejection of the probe and the qualitative interviews.

Given the problems recruiting, the exceptional nature of the participants who were recruited, and the lack of friend/family involvement. We had to consider how to take this project forward. Our options were:

- Continue as is:
    - There is a chance that we were just 'unlucky' with the pilot and that more people would be willing to involve their families this time around
    - Given the fact that the project needs to be completed within the timescale of the author's PhD, would this strategy be too risky?
- Continue as is, but extend to other hospitals:
    - This would give us a bigger recruitment pool but would increase the likelihood of recruiting from disparate classes (so no peer interaction)
- Continue with interviews only:
    - This would overcome the technology barrier, so we could speak to a more diverse group of people
    - Would provide us with further findings regarding existing attitudes and practices
    - No chance to observe the use of Collabohab

After careful consideration of the options presented above, we decided to continue our investigations into peer-involvement in cardiac rehabilitation without the technology probe. The following sections present the findings of the main study, in which many of the issues raised in the pilot study are recurrent themes.

8.5 Participants

Nineteen cardiac rehabilitation participants were recruited for the main study. The majority of participants were male (n=14). Of the five female participants, three were widowed, one was married and the other was living with her common-law husband. All but one of the male participants was married or living with their common-law wife, the other lived alone but had a long-term partner. One of the married male participants also lived alone. Apart from the gender bias, the participants represented a broad demographic: participants were aged between 43 and 78 (average age= 63.1; s.d. = 10.8) and occupations (and pre-retirement occupations) spanned the manual-professional continuum, including janitor, domestic, policeman, nurse, engineer and labourer. All of the participants had offspring (between one and six each), the majority of whom were now adults. In three instances, the adult offspring still resided with their parents and for five of the other participants at least one of their offspring lived 'nearby' or 'within walking distance'.

From a clinical perspective, an angina diagnosis had led to seven participants being recruited onto the cardiac rehabilitation; the remaining twelve had each had a heart attack (MI). Only three participants were treated non-invasively (only being treated with medication), the majority of participants had undergone an angioplasty[32] to 'unblock' at least one of their coronary arteries. A coronary artery bypass graft (CABG[33]) was the most invasive procedure that any of our participants underwent; one participant had a double bypass and two others had triple bypasses. The majority of participants had a family history of Coronary Heart Disease (CHD). Four participants knew that they had high cholesterol prior to their cardiac diagnosis, one had high blood pressure, two were diabetic—one of who was also clinically obese. Seven participants had no medical history of note. From a behavioural perspective, six participants smoked and five were ex-smokers. Other than one of the smokers who also smoked marijuana, there were no other reports of drug use (apart from prescribed medication). Eight participants drank alcohol regularly. Seven participants considered themselves to have healthy diets prior to their diagnosis.

From a technological perspective, every participant owned a mobile phone most of who used it daily (13/19). Three participants used their mobile phone weekly and one

[32] Angioplasty: invasive technique to unblock coronary artery
[33] Coronary Artery Bypass Graft: open heart surgey to replace blocked coronary artery with an artery typically from leg

participant stated infrequent use (monthly), for the most part the purpose of these phones was to keep in touch with offspring. The remaining two participants had never used their phones. Access to home computers was much more divided. Six participants didn't have a computer at home, five of whom had no experience with computers while the other one of whom was technically literate due to daily computer use at work. The remaining participants (13/19) all had computers at home, although as with the mobile phones, two participants had never used them. All but two of those who owned computers had over four years experience, the remaining two had less than one year's experience. Only three of the participants considered themselves to be physically active. Unsurprisingly, access to and experience with computers was negatively correlated with age.

8.6 Motivation

Recovery and behavioural change are two aspects of rehabilitation. Recovery involves regaining strength and confidence such that the individual can return to living life as normal, or as close to normal as is now possible. For cardiac patients with behavioural risk factors, those risk factors are a component of normal life. Although recovery generally involves participating in new behaviours, in the case of this rehabilitation programme it involves participating in two exercise classes a week for ten weeks, but an individual does not necessarily need to commit to maintaining those new behaviours indefinitely or modifying risk factor behaviours in order to recover. Rehabilitation staff do encourage participants to stop smoking, participate in physical activity, regulate dietary intake, and moderate alcohol intake, but the choice remains with the participant.

The reason that we highlight the distinction between recovery and behavioural change is that while all of our participants expressed a desire to recover (that is, to get back to normal), the degree to which participants were interested in making changes to their lifestyle and health-related behaviours varied widely. Not all participants share the same scope for behavioural change; some were smokers, drinkers, with unhealthy dietary habits, while others had simply become less active as they aged. The majority expressed the intention of continuing with the community-based exercise programme that was provided for those who completed the rehabilitation programme. Apart from three participants who considered their diet to be healthy enough, the remaining participants had all undertaken some degree of dietary change. For the majority this involved minor modifications, although four had attempted a complete overhaul of their dietary intake and cooking practices (three were successful). From the six participants who smoked, three had quit,

two had reduced their daily intake to five, and one continued to smoke. Alcohol intake was the least acted-upon risk factor. None of the five participants who were advised to reduce their alcohol intake did so, although two others reduced their alcohol intake without being prompted. Changes were made either because that was all they needed to change, or that was all they were willing to change. The issue of determining extent of change is discussed further in Section 8.7. Here we discuss the different responses to the cardiac event and their impact on behavioural change, before addressing what motivated continuing efforts, and if and how progress is measured.

8.6.1 The Behavioural Impact of a Cardiac Event

Regardless of lifestyle, all participants were shocked by their diagnosis. Reactions varied greatly between being considered to be a life changing event (P38) to being nothing to worry about (P43, P45), with the majority of participants falling somewhere in the middle. Four participants spoke explicitly about the occurrence of the cardiac event being a warning sign or wake-up call; all citing alcohol or smoking as risk behaviours. The remaining participants either had what they described as a moderate lifestyle, only making minor modifications, or did not problematise behaviours in the same way. For example, while P46 stated, "I would say I am about 30 years too late in doing exercises", he expressed no intention of becoming more active on a daily basis. In other words, while all participants engaged in some degree of behavioural change, those with moderate lifestyles did not regard the cardiac event as a wake-up call in the same way as those with more excessive behaviours. However, participation in excessive behaviours did not guarantee such an attitude shift. Perhaps the most vivid illustration of this observation is P43's story about the day before he underwent major cardiac surgery (triple bypass):

> *What I done when I was in that hospital... the [music] festival was on and I just took all the machines off and I went down to the [roundhouse] pub, you know they have a big party thing outside. I just thought, "I am offski[34]" and I went down and had a few pints and that... and then the guy... I had said to him, the surgeon guy "You need to let me out of here... I can't not, I can't go in for a major operation when I only left my house a month ago to come here and do some wee walking test" I said "I've not been home I've not been in my house for a month, my flat... I need to go and sort things out and what not" and they let me out on the Saturday for a few hours. Basically I just said 'Look can I not just make my way to the [other hospital] tomorrow myself, and I'll have a wee night [...] with my wife and that?" {winks} The doctor is like that, "Aye that'll be bloody right... you are not to change a light bulb." I said "Aye alright", obviously never told [Janis] that. Nipped in bed, quick, right, she is away and I*

[34] "I am offski" is Glaswegian slang, meaning "I am leaving".

> *am away back to [festival]. And I said "Right I am away for a couple of pints before I go back to the hospital." This is about 2.30 in the afternoon and I fell in the hospital door at 12.30 [...] So as I said, I kinds took it all in my stride, light hearted about it all saying "Well sod it, if I die I die, there is nothing I can do about it."*

From a clinical perspective P43 deceived medical staff and was irresponsible to physically exert himself in his condition and to get drunk the day before surgery. From his own perspective the risk of dying in surgery without having seen his wife or passing time in the pub with his friends was worth the risk of experiencing complications through doing so. Although an extreme example, it highlights issues that individuals may consider in parallel to health outcomes when determining what behavioural changes they will make in response to being diagnosed as having a cardiac condition. Relationships and experiences are also considered, and not necessarily to the detriment of health as could have been the case above.

8.6.2 Placing Behaviour in Context

As was mentioned earlier, recovery is an intrinsic part of rehabilitation and as such, getting back to normal is a goal and motivation in itself. For most participants, the time immediately after their cardiac event was followed by a period of rest and recuperation. During this time, participants were unable to carry out their usual domestic or professional duties. This period was a source of frustration for many participants, and returning to work or being able to go to the shop for groceries was a much-anticipated relief.

> *I was bored in the house. I mean there is only so much housework you can do, you know... and I am trying to help around the house, and then I would go for walks... you know... but I had to get back to work. I felt that I needed to get back into the same old routine again. [...] That was that, end of story, back to work. Back to living again, you know, back to your usual routine. P35*

In Section 8.8 we discuss the tensions that arose during the recovery period when participants had to negotiate a suitable return to normality with their families who were often concerned that the participant was trying to do too much too soon. Here we consider the three dominant motivations behind the participants' efforts.

8.6.2.1 Prescription: doing what I am told.

Albeit sometimes subject to self-selected filtering, many participants' efforts were driven by a clinician's prioritisation of a particular behaviour or sanctioning of existing

behaviours. The two participants (P42, P43) who had successfully stopped smoking had both had smoking pointed out as the major contributory factor to their condition:

> *They said that, smoking mainly. Because healthwise when they asked me my medical history, they said "Just through smoking that's what's blocked your [arteries...] You've been quite a healthy person." P42*

Both were keen to move on from the event and, apart from having stopped smoking, returned to a normal lifestyle. The sentiment of only doing what the clinicians tell you to was echoed by P45:

> *I'm fit now, I am alright. The doctors never said to lie down... just lead a normal life. So that is what I do [...] I just carry on life the way it is... I'm quite happy toddling along. if the doctor came to me and said 'look you will have to do this and you will have to do that', OK, but he hasn't actually said that.*

However, although P45 had been advised to reduce his alcohol intake (from 30 spirits a week), as had P35 (18 pints a week), neither had followed that advice. Both participants rejected the notion that they drank too much, a rejection perhaps enabled by the ambiguity of being encouraged to change rather than being told to change:

> *P35- If [my alcohol intake] is detrimental towards my health then I will change it.*
> *I- So if someone said that this is...*
> *P35- That I would need to change, then I would change. Yes.*

It is likely that the remaining participants who smoked had also been advised to stop smoking, given its clinical priority [83, 91]. However, for P32, the advice that resonated with him was not from the clinicians but from his ten-year-old granddaughter:

> *That was 5 month down the line... and I was 35 a day and I just chucked it... turkey, gone turkey. And the reason I meant to bring my wee card for you as well. My daughter drew a wonderful card... hand writing... with one of those no entry signs. Well she done one no smoking, and me lying in my bed with a puff of smoke coming out of my ears, and it is all scribbled 'Grandpa I want to see you live, please stop it now'. Now that is a wonderful card. Even the nurses in the hospital said that is brilliant. a 10 year old. that broke her heart seeing me lay in bed with all the wires, that really gave her a fright... and me... and my wife... seeing me wired up like that.*

Unlike P42 and P43, P32 did not constrain his behavioural change efforts to his smoking habit. Surviving his heart attack instilled a sense of responsibility in him to improve his lifestyle (see following section). Prescriptive motivations drove all of the participants'

efforts to a degree, in that they all agreed to participate in the rehabilitation programme. The overwhelming attitude towards the programme was that clinicians do not recommend something for their own sake. What distinguished those with primarily prescriptive motivations from others was the sense that they had made any corrections that had been deemed necessary and that any sense of change was now in the past.

8.6.2.2 Duty: being responsible for my health.

While almost all participants intended to continue with the community exercise classes provided by the rehabilitation service, some participants explicitly expressed a sense of duty or desire to continue the good work that had been started during rehabilitation. Many spoke of the rehabilitation programme as being a catalyst for forming positive habits, or as compounding existing efforts in those who had started to make behavioural changes prior to the cardiac event; motivated by a need to take care of yourself as you get older. Continuing and developing efforts further was a goal in itself for some:

> *Starting off with the exercise class twice a week is partly getting into the habit of doing something, getting a bit more active. Now that that has finished I am willing to take the next step and make the next move on it [...] And also just the fact that it has made me stop and take stock for myself of what I have been doing or not doing. Get on with it. P42*

P32 (quoted in the previous section) had made the most extensive changes of all the participants. He spoke of having been given a second chance and of not making changes simply not being an option. More usually, there was a degree of ongoing uncertainty or unsettlement in the participants who were motivated by their own responsibility to maintain and improve their health. P38 was one of the youngest participants, and had previously run marathons. He was aware that over recent years he had become inactive and identified alcohol intake and takeaways as additional risk factors. Echoing the pilot-study participants, he saw rehabilitation as his own personal battle:

> *I don't mean to sound dramatic but from my point of view I have seen it as a... I have got to understand my heart a little better, and understand what I can do, and see myself progressing and how much I can push myself. When I say personal I mean it from that point of view. Its me, its my body, its my heart and I have got to physically do it, nobody else can do it for you.*

In contrast, P48 was worried by the apparent discrepancy between lifestyle and mortality, concerned that he had had a heart attack despite living a moderate lifestyle:

> *My son says it is just fate, there is nothing you can do. He says that if your time comes your time comes [...] but at the same time I do realise that if you don't do these things then the odds are in your favour for living a bit longer.*

A sense of accountability seemed to instil a more durable motivation to continue efforts. However, the associated uncertainty or unsettlement risks becoming a source of stress which when excessive can itself become a cardiac risk factor. Rehabilitation participants are warned not to become obsessive about their condition, and to move on and get on with their lives, a message that all participants seemed to have taken on board. Rather than remaining focused on health or health-related behaviours, the final motivation is to make the most out of life.

8.6.2.3 Experience: wanting to enjoy my life.

Health, when considered in isolation, can seem an abstract concept. After all, what does it mean to be healthy? It is unsurprising then, to find experiential motivations and goals such as the ability to participate in everyday activities, looking forward to spending quality time with a partner or seeing grandchildren grow up. Having non-health related goals did not necessarily preclude behavioural change; they were the motivation behind existing efforts. They did, however, cast health-related behaviours as a means to an end rather than an end in itself. For example, P37 talks about his wife's reluctance and reasoning for not participating in exercise:

> *She keeps... she has never been up nor down, and she has always been overweight. She the classic wee fat wifey c you know, tiny and wide. But no... she has never been up nor down, and whenever I make a comment about "Do you not think you should lose a bit of weight?" [she replies] "Why? I am not going to go out for a run, I am not going to do this... I can do what, I can keep the house and all the rest of it. I am quite happy the way things are". She can look after the children and such like, and she is still OK.*

The ability to participate comfortably in the activities that are of importance to the individual, acts as a gauge as to whether remediative action (behavioural change) is necessary. P37 echoes his wife's priorities in his desire to be able to keep taking the dog for a walk, play with the grandchildren, and be able play golf when he wants to. He intends to continue with the community provision of exercise classes, but is not interested in altering his daily routine. Similarly, he has modified his dietary intake but it is important to him to be able to continue eating what he enjoys. Instead of having chips three to four times a week he will just have chips on a Wednesday, which is fish and chips night. When considered in isolation such behaviours can seem ill advised, but they are often meaningful

activities when considered as part of a routine and experience. P31, for example, drinks one Martini every night before she goes to bed, and was advised to have at least two alcohol free nights:

> *I said "Well tough. [My husband[35]] used to make me a Martini every night at 10pm and I will have that Martini until I die."*

All of the participants who identified the desire to enjoy life as a motivation all reported having very close relationships with their spouses, partners, or immediate family e.g.,

> *I don't think I have any more goals, just to live life, get as much out of life as I can. Spend time... we can have some quality time together my wife and I now. Kids are grown up, mother is being taken care of. So we can have some quality time together before we are stuck in the house all of the time. P36*

Others without such strong or close networks sought to seek out new avenues of social experience or mental stimulation (P31, P41), or lacked motivation in general (P39). We will return to the role that peers play in Section 8.8.

Experiential motivations draw attention to the broader context of rehabilitation. That is, its situation within an individual's everyday life. An individual's desire for quality of life can promote health-related behavioural change and delimit it. Enjoyment and quality of life, unlike engagement in a behaviour, is subjective. P47, for example, spoke at length about never being able to enjoy physical activity, while P40's overall goal was to be able to get back to cycling. What this means is that advice is considered in parallel to the impact that change will have on an individual's life. For some, such as P32, a complete change of lifestyle is deemed necessary. For most, changes are made within what the individual deems to be acceptable boundaries. How individuals go about negotiating and implementing change is discussed in Section 8.7.

8.6.3 Summary

When considering the issue of motivating behavioural change, it would be easy to presume that motivations do not come much bigger than suffering a heart attack. However, what we found was a range of responses; from it being seen as a wake up call to it being nothing to worry about. Attending cardiac rehabilitation, to use the words of the participants, is a "kick start". By agreeing to participate in the cardiac rehabilitation programme,

[35] The participant's husband had passed away the year earlier.

participants implicitly undertake a degree of behavioural change. The underlying motivation for participating in the rehabilitation programme is a combination of recovery and of doing what the clinicians advise.

The messages being conveyed by the rehabilitation staff were essentially common sense. The reason that participants responded now was a combination of the instructions being considered to be of more importance or relevance, and also because the clinicians were addressing them directly. The scope of potential for further behavioural change beyond what is involved in the programme obviously depends on an individual's lifestyle. Here we find a sometimes-conflicting motivation. People are essentially content with their lifestyles, and while they are keen to reduce the likelihood of a cardiac recurrence, they are also keen to return to the normal everyday activities that they enjoy. That is not to say that people were not willing to change their everyday habits. Those who expressed a duty, a responsibility to take care of one's health, made quite extensive changes to their lifestyles. Others changed only what was deemed necessary, either as determined by the clinicians or the participants themselves.

8.7 Implementation

The primary behavioural focus of the rehabilitation programme is on improving cardiovascular fitness through participation in physical activity. This is achieved through twice weekly exercise sessions for the duration of the programme, which the participants are given the opportunity to continue in a community-based setting upon completion. For the participants, the provision of a structured and supervised exercise programme alleviates the challenge of determining how to go about improving fitness or physical activity levels. All participants spoke positively about the programme, but the subtleties of the benefits that it afforded varied. In addition to physical benefits, some participants identified social and psychological benefits.

For the majority of participants, the programme served as a catalyst for latent intentions. As was mentioned in Section 8.6.2, habits were formed over the course of the programme that, more often than not, participants intended to continue or develop further. In addition to the process of developing a habit by repeating a behaviour over a period of time (in this case 10 weeks), the guidance and encouragement of the staff promoted self-confidence:

> *Doing it in the hospital with other people, it gets you into the routine before you set off for the gym on your own. Now I am more prepared and disciplined to go to the gym than if I hadn't [attended the rehabilitation programme]. P36*

Interestingly, the pseudo-authoritarian nature of the programme also added weight to the importance of the programme:

> *I said "I might as well, it is only going to do me good. I'm not going to do exercises myself." You know, you get that way... a wee bit lazy. Whereas you're going there, you have got to do it, and that's it. P45*

A few participants remained unconvinced about the physical benefit of attending the classes, either because they were already fit and had recovered quickly (P40, P44), or because they felt it was too late for them to get fit (P46, P48). For the most part they intended to continue with Phase 4 simply because it had been advised (as touched on previously in Section 8.6.2.1).

In addition to the new source of physical activity that programme attendance provided, many participants had existing patterns of physical activity that they intended to continue, (for example, walking the dog). All but three of the remaining participants were hoping to find additional sources of physical activity or had already integrated additional activity into their everyday routine (for example, by extending the morning walk for the paper). The decision of whether to implement additional changes other than those facilitated by programme attendance is discussed in the following sections: starting with the identification of problem behaviours, then implementing strategies to modify behaviours, and determining the extent of desired change.

8.7.1 Awareness as a Prerequisite for Conscious Change

Unlike physical activity, which was automatically increased through participation in the rehabilitation programme, the decision to voluntarily extend behavioural change efforts to include other forms of physical activity or other health-related behaviours relies on the individual being aware of a need for change. Awareness either came in the form of self-identification of problem and non-problem behaviours or through the identification of problem behaviours by health professionals. As we saw in Section 8.6.2.1, the identification of problems by health professionals relied on self-identification before changes were attempted. Here we focus on the self-identification and evaluation of problem behaviours.

Smoking was perhaps the most easily evaluated health-related behaviour in that it is always considered harmful. All of the participants who were still smoking or were in the process of giving up acknowledged that it was a damaging behaviour. In this sense, smoking as a CHD risk factor is unique; each of the others have a continuum of behaviours ranging in degree of perceived healthiness. The following examples illustrate the different metrics used to evaluate various health behaviours. Firstly, and linking to much of the work in this thesis relating to attitudes towards physical activity, participants would refer to being or more commonly not being a particular type of person:

> *I won't say I was active but I wasn't inactive. I play golf so I probably play at least once a week and get a bit of exercise each morning walking to the shop which is half way through the village. I would say it is a good 10 minute walk. A decent day, take the dog a walk, that sort of idea. I work in the garden. So I am not inactive but I was never one for... "oh we'll go for a jog", kinda style. I was not that active a person. P37*

Occasionally, recommended guidelines would be referred to. In the following example, P45 rejects the recommended guidelines (which he acknowledges he exceeds) in favour of his own subjective measure of whether he is a particular type of drinker:

> *Well Monday night I go out and play snooker and that is two rounds, so… 6 whiskeys or gins or whatever. Tuesday nothing. Wednesday night I only have maybe 4 gins or something. Thursday I am out with the wife so maybe 7 or 8. Saturday is big… so 9 or 10. I lose count after 9 {laughs}. Sunday is usually a quiet day, so I will maybe just have a pint. So I don't think that I am... I know I'm over the 20 but I'm not what you call a binge drinker. P45*

In other cases, participants would evaluate their lifestyle with respect to whether they participated or abstained from particular sub-behaviours. Perhaps reflecting the success of the recent '5 a day' campaign (mentioned in Chapter 2), consumption of fruit and vegetables was commonly referred to. Others gave examples of vilified behaviours that they abstained from:

> *My diet and my lifestyle has been pretty good to be honest you know... I don't eat junk food, I cook food. I don't eat packet stuff... I have it now and again but in general I make food from scratch basically and I always have. P42*

Arguably, dietary intake is the most complex of health-related behaviours to evaluate (see Chapter 2) and so individuals often singled out particular eating habits. This was most commonly done by those who considered themselves to have relatively healthy diets but sought to make what improvements they could:

> *I just decided that that was what the problem was, that I eat too many things in between meals. So I thought well if I am going to eat in between meals I am going to eat something that is not bad for me [...] so I went to walnuts which are healthy because they are high in protein and there is nothing else in them [...] I like dates. Walnuts and dates go perfectly together so that is what I usually eat and I like both of them. I would eat them occasionally before, and now I make a conscious effort to go out and buy them so I have always got them. P30*

In other cases, particular behaviours were prioritised because a complete change of dietary intake was deemed unfeasible:

> *I got it into my head that fat was important [...] I think you can become totally fanatical about the whole thing or... I made the decision that it was fat so therefore that is what I cut out. Everything else I just plod on and eat. P47*

The notion that people can take things too far, or that there are acceptable boundaries for change, was a recurring theme throughout the interviews. Indeed, P47 who is quoted above described her sister, who was the only member of the family not to have had a heart attack, as a fanatic who worried too much. Therefore, an awareness of particular behaviours may be a prerequisite of conscious behavioural change but does not guarantee it. The following section presents the competing values that individuals consider when determining the desirable extent of behavioural change.

8.7.2 How Far is Too Far?

In Section 8.6.2.3 we presented life experience, or quality of life, as a contrast to health-based motivation. Acceptable boundaries were defined in terms of taste, interest and enjoyment.

Interestingly, those who had undertaken large changes to their dietary habits did not raise taste as a problem. Large changes here being defined as changes made to daily meals rather than specific ingredients. Rather, taste was more likely to be blamed for the rejection of one particular food item such as olive oil-based spread or food group such as fruit. For many, abstinence from foods that they enjoyed eating would render behavioural change efforts unsustainable. P40 had dismissed his partner's attempts to persuade him to change his diet, laughingly referring to her as "the food fascist". However, he had changed his diet after consulting with the programme's dietician. When asked what differed between her advice and his partner's, he said that the dietician had been realistic about the changes that

he should make and reassured him that making modifications to his diet did not mean his diet had to be bland and boring.

Overall, participants were happy with their lifestyles and so in some cases only wanted to change what was necessary. Participation in the exercise classes was seen as the required change in physical activity, even if they acknowledged that there was scope for more on a day-to-day basis. When asked if he would find it useful to monitor his daily activity levels, P35 responded:

> *I just can't be bothered with it. It doesn't float my boat to walk about and be fit in that respect. I don't mind going to a gym and you know, sweating it out of me, for an hour and a half or whatever the case may be. In fact I would probably be doing more, hopefully, in that respect.*

Apparently at odds with the comment above, P35 had actually integrated a ten-minute walk into his daily routine. The idea of having an allocated time for rehabilitation concerns was echoed by others when discussing information and support seeking practices. As was mentioned earlier, rehabilitation participants are advised not to become obsessive about their condition. While a few did look up information about their heart and diagnosis on the Internet, the majority were happy with the level of information that they received from the hospital and cardiac rehabilitation teams:

> *I felt that I have had adequate information provided to me by the hospital and the rehab. That, to me… what is important, they would have given you. You can spend too much time getting yourself into all sorts of things. P36*

The variation between participants' acceptable boundaries of change is unsurprising when considering the broad scope of their lifestyles and conditions. Some of those who considered themselves to be healthy eaters went on to make minor changes, while others continued as they had previously. The majority of those with multiple risk factors made moderate changes. Those who expressed a feeling of duty, of being responsible for continuing the good work (as discussed in Section 8.6.2.2), were more likely to adhere to the behavioural change suggestions of rehabilitation staff than take a more selective approach.

8.7.3 Feeling Progress not Monitoring Behaviour

During the rehabilitation programme, participants learn to measure their heart rate at intermittent points in the exercise class either by manually checking their pulse or by using

a heart rate monitor. At week five, if the rehabilitation staff are happy with the participant's condition, the participant is taught how to self-monitor their own exertion levels by using the Borg Scale [41] that was introduced in Section 8.2. Instead of monitoring their heart rates at intermittent points in the exercise class, the participants self-categorise their levels of exertion.

Only two of the participants continued to monitor their heart rate after the rehabilitation staff had told them that it was no longer necessary. P38, who had used heart rate monitors before his heart attack when he was training for marathons, used them in order to continue pushing himself while objectively observing his degree of exertion and progress. P30 also checked his heart rate before, during, and after sessions in the swimming pool for similar reasons:

> *It is easy to do. It is an easy way of accounting for whether there is any sudden change or whether you are actually doing too much. I know what I can take my heart rate up to. As far as exercise is concerned I know what is safe to take it up to. And as long as I keep it at that level, if it goes above that level, I bring it down. If it didn't come back down then I would be concerned.*

Unlike P38, P30 chose to self-monitor manually. Like the pilot-study participants who had already established manual self-monitoring routines, he did not see the benefit in using technology to do the same task:

> *OK you can buy a pulse monitor and put it on your wrist or put it around your chest. What is the point if I can take my pulse myself? It's not difficult. I don't see the point in technology if it is just replacing something that you could do yourself just as easily.*

Additionally, he used the objective measure of effort alongside how he felt that day: what sort of day he was having and whether he was tired or not. Measuring progress was primarily done by feel, how an individual felt during exercise or on a day-to-day basis. P31, for instance was aware that she felt worse during her exercise class on a Monday and put that down to the five-day gap between classes and was seeking an additional source of exercise to break up the gap. Her overall physical goal was to get through her exercise classes pain-free. Feedback came in small advances, such as losing an inch around the waist or being able to get up from the chair without a struggle.

Perhaps reflecting the prescriptive nature of the rehabilitation programme and the broader focus of many of the rehabilitation participants, the overall attitude towards self-

monitoring anything other than how they were feeling was that it simply was not required. Several participants added that they would self-monitor if they were told to do it, or if asked to do so for a study, but it was not something they could see the benefit in. Like P38, P37 had used a heart rate monitor when he was younger when training for football, but said that it was unnecessary now since he had no intention of pushing himself. One participant added that ignorance is bliss and she would not want to be told how little she was doing (P42).

8.7.4 Rarely a Solitary Occupation

Although physical activity is the primary focus of the rehabilitation programme, rehabilitation staff provided information and guidance on how to implement further changes. For the majority of participants who considered themselves to be healthy eaters and then went on to make minor changes to their dietary intake, considering their own dietary intake alongside the dietary information that was provided by the rehabilitation staff produced actionable information. For others, the information that was provided was a matter of common sense. None of the participants reported being surprised by the nutritional information being provided, it was perhaps just a matter of being told the information when they were ready to hear it.

In contrast to such self-determination, some participants simply made the changes that the dietician told them to. Three male participants reported making quite radical changes to their dietary habits. In each of these cases, the wife of the participant was instrumental in cooking meals and making daily food plans for her husband. Two of the couples had placed the poster that the dietician had given them in the kitchen to be used as a reminder and a point of reference. Two other male participants reported having given the nutritional leaflet to their wives; one wife also altering her cooking habits accordingly (albeit to a lesser degree), and one wife buying fresh food for a couple of weeks, but soon reverting back to frozen meals.

Unlike the independent battle to increase physical fitness that we observed in P38 and the pilot-study participants, an acceptable dependency was observed when considering other changes. For example, P37 appreciated that his wife would no longer let him smoke in the house in an effort to assist his attempt to stop smoking. The details of family involvement in behavioural change are presented in Section 8.8, but it is mentioned here to highlight the sometimes collaborative nature of implementing change in the home.

8.7.5 Summary

Much of the challenge of determining and carrying out a plan of change to levels of physical activity is alleviated by participation in the rehabilitation programme. When determining additional changes to be made, participants depended on instructions from the clinician or their own awareness and prioritisation of problem behaviours or avenues for improvement.

The degree of change was then determined by what the individual considered to be acceptable boundaries of taste, enjoyment, or interest. Modification and substitution were common alternatives to complete dietary change, whilst additional changes to physical activity levels generally took the form of extending participation in existing activities, rather than introducing new behaviours. Furthermore, perhaps reflecting the urges of the cardiac rehabilitation staff not to become obsessed about their condition, and the attitude of doing what the clinicians advise is all that is required, the time spent in the rehabilitation class was seen as allocated heart time. Once over the initial recovery period, further reflection on the cardiac condition and health-related behaviours was considered excessive.

Finally, while physical activity was primarily considered to be an individual activity, dietary changes lent themselves more easily to collaborative change due to the dependencies and roles that exist within domestic relationships. The following section explores collaboration around change and rehabilitation in more detail.

8.8 Collaboration

As the saying goes, no man (or woman) is an island. Although a cardiac event 'happens' to an individual, it is also experienced by their peers—primarily his or her immediate family. Peer-involvement typically took the form of practical assistance, behavioural guidance or emotional support. The degree to which family members were involved in an individual's recovery and rehabilitation depended on many things including perceived need for support, desire for independence and social proximity (geographic and emotional). We will present the various forms of involvement and attitudes towards peer-involvement in the remainder of this section. First we will consider examples of breakdown in peer support to introduce some of the upcoming themes.

8.8.1 Breakdowns in Support

Three participants voiced dissatisfaction with the level of support that they had received from their families.

P42 is a widow and her two children both live in different parts of the country. Immediately after her heart attack her son visited and stayed until the day after she was discharged from hospital. When asked if she got the emotional support she needed from her family she said:

> *No. I did at first, but now that I am on the mend I don't get any. The only thing is that [son] calls every day, [daughter] calls whenever [...] It has tapered off because I am back on the mend again. I just wont be a burden to my family. This is it, I won't allow them to... I still like my independence [...] If you are there, fine. But when I came out of the hospital... I came out on the Wednesday and my son was going back on the Thursday. And you know I was quite relieved at that to be honest with you, because I had the house to myself again. Every time I moved he said "where are you going?", I said "the bathroom", "I'll be at your back." He would follow me up the stairs and then wait... in case I fell back down the stairs.*

P42 was unusual in that she was simultaneously expressing a lack of support while complaining about being mollycoddled. She was fiercely independent, having brought up her two children alone after the death of her husband, and she was aware that her son and daughter cared for her. Her dissatisfaction was not necessarily related to her cardiac condition but to her everyday isolation. The reluctance to be a burden on her family was evident in her response to being asked how her family could be more involved, when she said that she wished that she had had more children and then maybe one would have lived closer by (rather than make even hypothetical demands on her existing children). The issue of burden is revisited in Section 8.8.3.

P39 lives with his wife and two young children. After his heart attack he had attempted to improve his dietary intake and wanted to stop smoking. His wife traditionally did the grocery shopping and he cooks the food. She initially supported his dietary changes by buying fresh ingredients, although after two weeks she had reverted to buying frozen meals. Additionally, he felt that her smoking had limited his efforts to stop smoking:

> *Well she tells me not to smoke, but she is still smoking. I think if she didn't smoke... when I came out of the hospital then I would have stopped altogether because I had stopped for three weeks anyway. It's harder when someone else in the house smokes. you are just sitting there and the smoke is coming in. "Give us one fag", then "give us another one"... then that is it. It starts again.*

He had asked her to stop smoking but did not persist because he felt there was "no point, she doesn't listen." Of all the participants, he seemed to have the most trouble articulating or reflecting on his feelings about recent events. At times he seemed a little apathetic, identifying problems without speculating potential solutions, or identifying goals without offering plans or intent. While this may be symptomatic of the aforementioned articulation issue, the fact that he was the only participant who reported not having exchanged friendly banter with the other rehabilitation participants, or having felt the need to ask the rehabilitation staff anything during the rehabilitation programme, suggests a lack of ability or initiative to seek out support.

Possibly the most extreme example of a breakdown in peer-support comes from P41's experience. P41 lives at home with her husband and looks after her granddaughter every day while running a family business. The night she was discharged from hospital after having been diagnosed with angina and having had a stent inserted, her family made her dinner. Her daughter bought her a mobile phone and asked her to carry it with her, as a security measure so she could call for help. Apart from those two events, none of the family responded in any way to the cardiac event. Her daughter-in-law dropped her granddaughter off to be looked after as usual the next day. She was offered no practical or emotional support. P41's situation was the exact opposite of many of the other participants' experiences, who had to negotiate a return to normality with their family. It became apparent that her husband, who had relayed the information of her diagnosis to the rest of the family, did not understand that she had a heart condition:

> *Last week, I said to [my husband], "Well I've got a bad heart" and he said, "No you haven't", and I said, "I have got a bad heart", and he said "No, you only had a bad artery" and I said "But I think that is all the same, your heart is your arteries and your..." [...] I don't think he knows what I had. He said 'You had a bad artery'. And I don't really know... is that not part of your heart... your artery? I go to cardiac rehabilitation, cardiac means heart.*

Despite being upset by the lack of concern expressed by her family, she did not raise the issue with any of them. When asked why she had not spoken to them she said that she had not wanted to upset the children, and that she and her husband did not have the type of relationship that they would ever speak about things like that. One of the rehabilitation staff referred her to a counsellor who helped her deal with her diagnosis and her family's response. Interestingly, it was only after seeing the counsellor that she started chatting to the other rehabilitation participants.

These three examples have highlighted several aspects of peer-involvement that, when lacking, leave the individual feeling unsupported. They also illustrate individuals' attitudes towards peer-involvement, or more specifically, their relationships, which has implications for any potential alteration to the status quo. While P42's family were obviously concerned about her, the distance between them left her somewhat isolated. P39's wife seemed to be obstructing, rather than supporting, her husband's behavioural change efforts. P41's family were almost unresponsive, causing her to feel confused and depressed. Not wanting to be a burden, none of the participants had discussed these issues with their family. Furthermore, the issues did not seem to be exclusive to the cardiac condition but rather stemmed from the nature of the existing relationships.

8.8.2 The Multiple Forms of Peer Support

This section explores three themes that emerged from the consideration of peer involvement in rehabilitation, each of which has been introduced by the examples above. The themes are aiding recovery and supporting change, influencing behaviours, and expressions of care.

8.8.2.1 Aiding Recovery and Supporting Change

One of the most commonly cited sources of support from peers was practical assistance with domestic tasks during the early stages of recovery when participants were advised not to, or were unable to carry out their usual domestic duties. Spouses typically did the shopping, cooking and housework. In cases where there was no spouse, with the exception of P42, daughters generally took on that role. In a few cases neighbours would also offer to help with heavy tasks such as putting the bins out, or would let the individual know that they were at hand if they were ever needed. In each of the cases where neighbours had offered to help, the participant was either widowed (P31, P34) or the participant's wife was physically incapacitated (P36). Other ways in which immediate family helped was by driving participants to appointments, and in some cases accompanying them to appointments.

The only participants not to report having had such practical input from their family, friends or neighbours, were P30, P33, P41, P44 and P45. Apart from P41, who as we mentioned earlier had a family who did not seem to acknowledge or respond to her condition, the remaining participants reported having quick recoveries and saw no need for

any practical assistance. The speed of recovery and need for assistance does not appear to be obviously correlated with diagnosis and intervention, between them they represented almost all of the combinations represented by the other participants: two had had a heart attack and two had angina, and their clinical interventions ranged in invasiveness from medical management to a stent and a double bypass. They were all male, each considered himself to have a healthy diet and none of them smoked (one had quit six months prior to his heart attack), but all acknowledged that they weren't physically active and two were heavy drinkers.

As well as providing practical assistance if required, spouses were also in positions to support individuals' behavioural change efforts. This is especially true if the spouse is responsible for cooking meals. As we saw earlier, several wives were instrumental in the facilitation of dietary changes for their husbands. Somewhat surprisingly given her reluctance to confront her husband about the lack of support she had received, P41 had also insisted that her husband also make the dietary changes that the dietician had advised. Of all of the cohabiting males, only three were responsible for cooking. For the most part, spouses adhered to the new dietary intake themselves. One exception was P30's wife who had always eaten different dinners as a matter of personal preference.

While spouses were often involved in supporting or instrumenting dietary changes, they were rarely involved in changes to physical activity levels. The only two exceptions to this rule were P33 and P38, each of whom had already started increasing their physical activity levels prior to their heart attacks. While P38 expressed the sentiment that his recovery and future improvements in fitness were a personal challenge (see Section 8.6.2.2), P33 conveyed the sense that changes to lifestyle were of mutual concern and mutual benefit:

> *Going out walking, going together. It's not a solitary occupation, and that is what I was saying I am looking at the gym, [wife] as well, er... she has been getting assessed in terms of weight and heart and so on. Her brother died when he was 50, of a heart attack [...] we will keep ourselves working together.*

For the remaining participants, spousal involvement in physical activity was either not possible due to physical constraints (P30, P36) or more commonly dismissed because there was no perceived need for their partner to become more active or the partner did not like exercise. Similarly, changes to smoking and drinking habits were primarily solo activities. In only one case did a spouse assist in her partner's attempt to stop smoking by forbidding the latter to smoke in the house (as was mentioned in Section 8.7.4). Along with P39,

P47's partner also had continued smoking when she had been discharged from hospital. We were unable to discuss fully the implications of her partner's smoking, as he was present during the interview. Unlike P39 who had managed to maintain a reduced daily cigarette intake of five, P47 had resumed her pre-heart attack intake of twenty cigarettes per day.

In the two cases where the participants had reduced their alcohol intake, one stopped drinking with her husband in the house, P44 speculating that the only reason his wife had been drinking in the house was because he had been. Unlike P44, P38 drank mostly in the pub. He had not drunk any alcohol since his heart attack but had continued to go to the pub, and he had no problem sitting in the pub while his friends and partner continued drank alcohol:

> *You know I have been back in the pub lots of times with my friends just having soft drinks and I have got no desire to have any pints of Guinness, or any kind of alcohol. It's kind of in my head now that I have done all this hard work and I want to maintain it. I am not saying that I am never going to have a glass of wine or a pint of Guinness again, it's just I have no desire. So why bother if you have no desire?*

Practical involvement in behavioural change was observed through facilitation and co-operative participation or abstinence. Collaboration appears to be more suitable to dietary change whereby one particular person is responsible for the provision of family meals. Only in these cases did participants specifically ask for assistance with making behavioural change. Any other form of involvement relied on the proactive initiative of the peer. Despite the potentially social nature of smoking, drinking and exercising, they seem less obviously adept to collaborative change. By asking an individual to change their cooking practices you are asking them to help you make the changes you need to. Any dietary behavioural change on their part is secondary or implicit. By asking an individual to change any other behaviour, even if the overall reason is to assist you, the need for them to change is then made explicit.

8.8.2.2 Social Influence: From Encouragement to Emotional Blackmail

Peers, primarily spouses or children, attempted to verbally influence the behaviour of the rehabilitation participant in a variety of ways. The verbal strategy employed by the peers depended on the behaviour that they were trying to promote or prevent.

We have already mentioned the tension that can occur during the recovery period when the individual is considered by family members to be doing too much too soon. The typical response of the family member is to instruct the individual to stop performing the offending activity. In one case a participant described his wife's response to him persuading his GP to let him return to work while waiting for cardiac surgery as "she went off her head" (P44). Less potentially confrontational strategies, and also less frequently employed, is for the family member to prompt reflection on whether or not the individual thinks it is really necessary to be doing that particular task or suggest taking a rest before continuing. Although these incidents are often referred to as sources of frustration, for the most part the individual understands that the underlying motivation behind the family member's comments is caring concern (see Section 8.8.2.3). In some cases the family member is perceived as being over-protective or over-reacting, or not understanding how physically fit or capable the individual actually is. However, in other cases the individual acknowledges that the family member is in the right to raise the issue, as was the case with the P44's aforementioned attempt to return to work:

> *I think I had mentioned [wanting to go back to work] but she was dead against it from the start. I never went back anyway {laughs}, I was off for 6 months [...] I was OK because I knew, because I knew in my heart of heart that I shouldn't. I knew that if I had overdid it, I mean I cannae switch off, I go at it hammer and tongues. I knew I could have done myself some damage… I more or less agreed with her.*

It was rare for participants to go against what the family member said, although a compromise was sometimes sought or explained. Despite his wife's protests, P35 was keen to return to work following his angina diagnosis and stent insertion:

> *So we came to an agreement that I would go by the book for the first couple of weeks. Do what everybody told me to do. And after that I would try and get myself back into a... you know. And then I went to see the doctor and she had given me a four-week line. So after four weeks I did... I was bored in the house.*

P36's daughter often pulled him up for doing odd jobs around the house:

> *If I don't come and sit down after I come back with the dog, or if I am doing something, you know... "Is that necessary?" So I say "I am only going to do this for a little while, yes it is necessary, all these things build up." I feel that if you don't, that can play on your mind "that ain't done yet", and then something else comes along and that is two things that aren't done. So you have got to spread it out, little and often.*

In addition to guarding against over-exertion, there were occasions when a family member would make comments to the individual that indicated that he or she was monitoring the individual's progress or participation in a particular behaviour. This was not a common phenomenon, only being reported by three participants, but the examples provide interesting points for consideration. The co-located family of P32, P37 and P48 made supervisory comments. In each case the family had been instrumental in facilitating change. Like the degree of change each was making, the degree of supervision varied for each participant.

P37 emphasised the importance of making moderate and sustainable change. He commented on his wife being a "nagging wee git"[36] by pointing out how many cigars he had that day, but appreciated the efforts she had made to help him quit.

P32 had made extensive lifestyle changes, his dietary changes being facilitated by his wife and his smoking cessation prompted by a card that his granddaughter made for him. He had also reduced his alcohol intake, but continued to go and socialise at the pub. His daughter monitored his drinking habits by going to the pub to check how much he had had to drink, on occasion even asking the staff how much they had served him. While this may seem invasive, when asked how he felt about her doing this he replied:

> *Alright, to be honest with you. Quite right. After what I put them through. I saw her face when I had all these wires on my body, I had a total of 18 wires on me, I was wired up for two days. I wasn't a pretty sight. You should have seen her face, and I knew then. She had a good talk with me, and she said "I will be looking after you."*

Like P32, P48's wife had facilitated his dietary changes by changing her cooking habits and making a daily meal plan. As was mentioned in Section 8.6.2.2, P48 was struggling to adhere completely to the new dietary regime, his problem being that he continued to snack on toast or sandwiches. Both his wife and his son would point out to him when they had seen him snacking. Again, he appreciated the fact that they had invested time and effort into helping him and were continuing to do so. The fact that they were persisting with him indicated that they had not given up on him.

The final aspect of influencing behaviour through talk is explicit encouragement from immediate family. Two participants stated that it was their wife who persuaded them to

[36] "Wee git" is Glaswegian slang, meaning someone who is an annoyance.

give the rehabilitation programme a try. Other examples of encouragement include calls to remain positive and maintain efforts. In gestures similar to the handmade card asking her granddad to stop smoking, emotional blackmail was also reported by three other participants: P30's younger brother emailed him telling him "Look after yourself, I don't want to be the eldest brother", P36's wife told him "you are no good to me if you are not here", and P48's son told him:

> *I can see it the now when you are in the hospital and the doctor will say "Oh hello Mr [x] you are back." He said, you have got to try harder... and you would say to the doctor "I am trying", or "I need to try harder", but you have got to do it.*

None of the examples above were singled out as the motivation for change in the same way that P32 attributed the card from his granddaughter as the reason for his smoking cessation. However, it is easy to appreciate the hard-hitting nature of such comments. As with gestures that could be perceived as interfering, participants understood and seemed to appreciate the underlying emotion that they conveyed.

8.8.2.3 Expressions of Care: Banter, Being There, and Showing Concern

There was an implicit understanding that the motivation behind the verbal and practical interventions of friends and family was the fact that they cared. The feeling of care and concern was important to all of the participants, perhaps best illustrated by P41's reaction to an unresponsive family. Even the more independent participants, or those who felt that there had not been a particular need for support, valued the input and interest of their family. P40 recovered quickly from his angina and stent insertions, and by his own evaluation had not needed any practical assistance from his partner or family. His family lived in other parts of the country, yet unlike P42 the distance did not appear to leave him feeling isolated or unsupported, perhaps because of the presence of an extensive network of friends. When asked how his family had supported him from a distance he replied:

> *I just think that it is the level of empathy that they actually project, because I know that if it was sympathy... I mean most people can tell the difference between "There, there" and "it'll be ok"... because my opinion of people who pat you on the back and say "There, there it'll be ok", that it is for their own sake. They want something to stop. You know? Rather than actually, it is a two way process and [...] you know if you can recognise the closeness that you have with the people that are supporting you. [...The support that] I got was caring and genuine. Just verbal support and interest. Because there are a lot of people who if you said this had been happening would change the subject. Or blank off. But that never happened.*

Another mark of genuineness was that expressions of care were in character. Peers described as overprotective or mollycoddling were usually prone to such behaviour. A peer behaving in usual character was reassuring to participants, as it indicated that the peers were coping with the diagnosis themselves. This was especially true in the case of teenage children who had temporarily become very attentive; returning to normal generally was marked by joking references to the cardiac condition:

> *I was happy to see him get back to his cheeky self, a 15 yr old boy shouldn't have to worry about his dad, before long they were kidding and joking about it […] just maybe physically carrying on and then he would threaten to give me another fright, another heart attack. It was just good banter but it was good for me to see that he wasn't sitting and obsessing about it. P38*

Just by being there, through phone calls, email or in person, by visiting and bringing books to read during recovery or being available to go for lunch, by showing that they are concerned, a sense of belonging is created that is an acknowledged benefit of social support [66, 123]. Additionally, these expressions of care provide a safety net of anticipated support that the individual knows that he or she can call on if needs be. The following section discusses participants' attitudes towards the support provided by friends and family, and perspectives of independence that govern their willingness to call on such support.

8.8.3 Perspectives of Independence

Participants appeared to subscribe to one of three broad perspectives of independence and social support: that it was usual and acceptable to be dependent on a core group of family members during times of crisis, that it was desirable to maintain a degree of independence from others so as not to become a burden, or that while support was appreciated it was not central to rehabilitation. This section covers each of these themes in further detail, before discussing the information disclosure practices employed by rehabilitation participants.

8.8.3.1 Acceptable Dependency

For many, the concept of an acceptable dependency on a core group of peers extended beyond the scope of their current condition and recovery. Reflecting the mutuality of relationships, support was also reciprocal in nature. For the most part the notion of acceptable dependencies applied to immediate family, or "your inner people" (P32). Similar things that family members were doing for the individual, at this time, had been

done by the individual for them in the past. Alternatively, they would be happy to do something similar in the future. In this sense, the actions of peers were not considered to be out of the ordinary:

> *When push came to shove, they were all shoving. And that is the easy way to say it. Like most families, you don't live in each other's pocket. But for family we are all together, the three musketeers: one for all and all for one. And I imagine all families.. or 99.999% of families are like that. You don't live off each other but we are there to help. P37*

Again a sense of normality emerges from the provision and receipt of social support. Building on the notion that the ways in which peers expressed concern for the individual reflected their usual character and their relationship with the individual, so too was any support or dependency a reflection of the nature of the relationship

8.8.3.2 Independent Resistance

In contrast to views of acceptable dependency, those who expressed resistance to the support being offered to them, did so to maintain their own independence but also for fear of becoming a burden. Three of the four participants to convey such an attitude were widows, two with family nearby. Interestingly each of the female participants had had experience of having to look after a demanding elder in previous years. In two cases the elder had been their mother, and they were keen not to let history repeat itself. None of the participants said that she had ever stopped herself asking for help when she had felt she had needed it, but P31 did state, " I am very aware that nobody wants an old bat that asks for things." P48 found himself in a different situation, in which he felt his family had given him all the help and support to change his dietary intake that was reasonable to expect of them:

> *I think she is doing remarkably well. Not only is she producing what I should be eating, but she is also saying, just like my son, "You shouldn't be eating that." But as I said to you earlier I am an adult and she cannae forcibly stop me from what I find difficult… I mean, being honest about it… I mean I could go in [to the kitchen] and she will be sat in here watching the TV. I could say I am going to make a cup of tea… she doesn't know what I am doing in there. If you know what I mean? I mean she cannae walk in behind me. Well she could, but I wouldn't ask her to do that and she wouldn't ask me to do that. But that's… that's almost what is needed to get me to [stop snacking].*

So like the female participants he had drawn a line that he was unwilling to cross, albeit a more liberal line that allowed his family to be more actively involved in supporting his

efforts to change. Unlike the female participants who did not feel that further dependence was necessary, his desire to avoid becoming a further burden on them had prevented him from asking for further help.

8.8.3.3 Soft Support

Finally, there were those who appreciated the support that was provided by their peers, but regarded it as supplemental, not integral, to their individual efforts. Echoing the sentiment of the two pilot-study participants, the task of behavioural change was down to the individual. Apart from P38, all of the participants who viewed the peer support as supplemental had made the changes they had hoped to and had not required much support due to a quick recovery, or had failed to maintain their attempted behavioural changes. The latter participants were perhaps keen to divert any potential blame from their peers, instead highlighting the fact that any responsibility for change lies with the individual:

> *I know [physios] were saying to her 'you know, encourage her, tell her to go for walks' and all that, because [sister] is into it and I am not. It is her bag and its not mine, and [sister] said "I cannae make her go, I can only ask her."* P47

8.8.3.4 Selective Disclosure

Participants were relatively open with their peers about the process and experience of rehabilitation, especially with those who were co-located, and so the experience was shared implicitly. Rather than raising the topic themselves, discussions would often be prompted by the peer when enquiring as to how the individual was feeling. The participants never highlighted this as a conscious strategy to deal with managing the level of disclosure or burden, but more reflected the natural process of putting the event behind them. A few participants spoke of the initial desire to tell people their stories, but how over time that desire eased as time passed. P38 reflected on the difference between how he handled his heart attack and how his cousin handled his, whom he thought had been a little obsessive:

> *He was always continually reading up about it and always wanting to talk about it, always, always, always. Which is good and I guess I was like that in the early days, because you do naturally talk about it. You see lots of people, people that you maybe haven't seen in a while... you tell them your story if you like. But eventually, after a while... it's not a case of you don't want to talk about it but... you want to move on and get on with your life, and do the normal things and go to work.*

P31 was the only participant to refuse to let any family members attend her clinician's appointment with her. Similar to the other widowed participants, she described herself as "fiercely independent" and, reflecting the influence of prior experience, commented on how everybody had known her husband's business when he was dying of cancer. Not allowing her family to attend her appointments meant that she retained control of her clinical information, even if she did subsequently tell them everything that had been discussed:

> *I tell them what I know but I don't want them to come in and ask questions [...] I tell them everything actually. But I do the telling.*

To avoid what they considered to be unnecessary worrying, participants also employed a degree of protective filtering to what they told their peers. Not bothering them about every twinge was a recurrent theme from the pilot-study, although in P38's case he pre-emptively warned his partner that he was likely to continue getting twinges and so if she saw him flinch then she was not to worry.

Therefore, selective disclosure affords the individual control over their own information and subsequently control over how much they impose on their peers, the motives for which can be selfish or altruistic.

8.8.4 Summary

This section has presented the many ways in which an individual's peer group can help or hinder an individual's recovery and behavioural change efforts. While there were isolated examples of friends and colleagues becoming practically involved, it typically came from a core group of family members who, if not collocated, were usually adult offspring. The bulk of support that came from outside the core group came in the form of caring enquiries and offers of assistance and company.

Even at times when the peer's efforts were a source of annoyance to the individual, an appreciation of their underlying motivation made them not just bearable but valued. The recurrent source of tension between individuals and their family arose from a concern that the individual was overexerting him or herself. In some cases the concern was justified and the individual would take on board the peer's suggestion that they take it easy. In other cases the individual reassures the peer that they are physically capable. This tension is symptomatic of the contextual isolation that exists between the individual and their peers.

In some respects the peer's concerns are similar to the uncertainty that the individuals' feel about what is physically possible after suffering a cardiac event. For the individual him or herself, these concerns are appeased through the supervision and guidance provided by the cardiac rehabilitation team over the course of the programme. The peers, however, have to gain confidence by proxy.

Contextual isolation also was evident in the presence or absence of peer-involvement in particular forms of behavioural change. While participants were comfortable seeking assistance from spouses in making dietary behavioural changes, there was far less collaboration with changes to physical activity levels. As was mentioned in the previous section, this in part can be explained by the natural dependencies that exist within the home with respect to the cooking of meals. Also, we suggest it reflects the personal nature of recovering physically from a cardiac condition i.e. a personal battle, and it is evident of the prescriptive attitude towards behavioural change. Changes to physical activity levels were only really necessary because they had been prescribed to the individual. Even in cases where a spouse was inactive, change was desirable but not deemed necessary.

Finally, we found that while participants were generally open with their peers about their condition and their rehabilitation, they would normally wait until prompted before talking about it. Prompted and protective disclosure simultaneously enabled participants to control the level of disclosure and reduce the likelihood of being a burden on their peers.

8.9 Discussion

One of the motivating factors behind our investigation of cardiac rehabilitation as a behavioural change domain was that we wanted to explore the social dynamics of behavioural change within a population who had a vested interest in making such changes. The underlying assumption was that those who are diagnosed with a cardiac condition would want to make behavioural changes. To a degree, this assumption was found to be true. By participating in the cardiac rehabilitation programme, individuals automatically introduced two hours of physical activity into their weekly routine. The vast majority of participants expressed a keen intent to continue attending exercise classes that were provided by the rehabilitation service at local community centres. However, attitudes towards making additional behavioural changes varied greatly between participants. This reflected both the broad variety of lifestyles among the participants and their willingness to change. Some participants were already living what would be considered to be relatively

healthy lifestyles while others could identify multiple areas of excess. Some participants undertook radical changes, while others focussed on single behaviours. The degree of peer involvement was similarly varied, independent efforts being made out of choice in some cases and out of necessity in others, and active involvement including aspects of both support and control.

The remainder of this chapter is structured around the three main topics of the thesis that were used to frame the findings presented above: motivation, implementation and collaboration. The discussion within each section will build on the findings of this study alongside the related literature that was presented in Section 8.2. In our discussion of the motivational issues that were raised in this study, we consider whether and how technology can incorporate alternative motivations other than those that are purely health-driven. The discussion surrounding implementation extends this somewhat by considering the role of self-awareness and personal choice when determining the extent of behavioural change, and suggests ways in which technology can contribute. Finally, we discuss the importance of the emotional gestures that are implicit in words and actions of friends and family, and the implication that this has for the design of technologies for those with no existing support networks.

8.9.1 A Place for Technology?

In contrast to the financial barriers to technology that were observed in the Families at Risk study (Chapter 7), this study highlighted issues of access and resistance that have implications for the likelihood of technology adoption by population. We do not suggest that all technology developed for this population will be rejected, throughout the UK cardiac rehabilitation programs are developing online programmes for those who cannot or do not want to attend rehabilitation in-person. However, the question remains as to how technologists should design for a population that is not comprised of early adopters [177], if at all. On the one hand, there is the argument that "user's don't know what they want"; that people cannot always envisage how technology could be useful to them, and as such innovation should not be constrained by a lack of perceived value before value can truly be appreciated. On the other hand, technologists should be wary of what Chandler [60] refers to as the technological imperative:

> *The doctrine of the technological imperative is that because a particular technology means that we can do something (it is technically possible) then this action either ought to (as a moral imperative), must (as an operational*

> *requirement) or inevitably will (in time) be taken […] The technological imperative is a common assumption amongst commentators on 'new technologies'. They tell us, for instance, that the 'information technology revolution' is inevitably on its way and our task as users is to learn to cope with it.*

Ackerman [1] identifies a similar argument against the significance of the social-technical gap between the nuances of social activity and the limitation of current technical capabilities to support such social activity, but goes on to make the counter argument that, "a central premise of HCI is that we should not ***force***[37] users to adapt." However, it is tempting to draw the conclusion, from the low levels of technological access and reluctance to use new technology that was observed during this study, that although everyday behavioural change technology seems infeasible for this generation of cardiac rehabilitation participants, they are likely to be better suited to the next, more technically fluent, generation. There is one assumption inherent in such a conclusion that we will touch on here. Resonating with the technological imperative is the assumption that it is inevitable that future generations will be technically literate:

> *Talk of a "digital generation" or people who are "born digital" wilfully ignores the vast range of skills, knowledge, and experience of many segments of society. It ignores the needs and perspectives of those young people who are not socially or financially privileged. It presumes a level playing field and equal access to time, knowledge, skills and technologies. The ethnic, national, gender, and class biases of any sort of generation talk are troubling. [244]*

In the above quote, the author is specifically concerned with judgements made about all youth that are generally based on the practices of "wealthy, white, educated people", and furthermore questions the very notion of generation. If, as the author suggests, that not all youth are as "tech-savvy" as is commonly thought, then that has obvious implications for the technical literacy of future cardiac rehabilitation participants, particularly when considering the need to avoid further exacerbating the already extensive social inequalities in health that have been discussed throughout this thesis.

The question of how to remain sensitive to the needs of a population while allowing for technological innovation is one that cannot be conclusively answered within this thesis. As will have been evident throughout the body of this thesis we advocate approaching the problem space from the perspective of the individuals themselves. This is not a novel suggestion, it is at the very core of Value-Centred HCI [69]. By first aiming to understand

[37] Emphasis added by author.

what is of value to the population, we can shape future innovations that are subsequently more likely to resonate with that population. Our thoughts on how technology may contribute to this population's needs are presented in the following sections.

8.9.2 Motivation: accounting for competing values

Suffering an angina or heart attack, and undergoing subsequent clinical interventions, temporarily focuses an individual's attention on his/her health and mortality. Some individuals did not focus long or deeply, or change their behaviour as a result, and so—to be somewhat pedantic, admittedly—if a heart attack does not motivate change then what chance does a pervasive health application have? It would be unrealistic even to suggest that any technological intervention could emulate the refocusing effect of a cardiac event, but we might at least consider interventions designed for use following such an event. Effort should be made to develop applications that assist the individual once refocused. Recall Heidegger's analogy that was introduced in Chapter 3, of a tool that becomes present at hand: it demands analysis and cognisance before it can become ready to hand again. While technology may not have the effect of a heart attack in making the body present at hand, it can assist with the analysis and any corrections required, as will be discussed further in Section 8.9.3.

In addition to the obvious motivation to recover and reduce the likelihood of recurrence, more subtle motivating factors influence the detail and degree of behavioural change. At the most basic level, individuals trust the advice given to them by health professionals and accept the beneficent nature of the advice. Rather than telling individuals to change everything about their lifestyles, health professionals would often prioritise and focus on one health behaviour. Without prioritisation, studies have shown that cardiac patients often attempt to make too many changes at once [70]. As we found in this study with those who had only implemented the changes prescribed to them, a dependency on health professionals to identify behaviours to change may reduce the likelihood of any additional changes being made but increases the sense of duty to carry out the specified changes. This suggests that systems should present prioritised changes in cases where there is the potential to make multiple behavioural changes.

We found that when individuals internalise the responsibility to determine change they seek to extend the benefits gained during the rehabilitation programme by implementing additional changes. Teaching self-management strategies has been found to improve health

outcomes in patients with chronic conditions and efforts are now being made to develop web-based self-management education modules for people with heart failure [139]. However, there is a distinction to be made between people who have been diagnosed with a chronic disease and people who have experienced an acute health crisis. This was illustrated in this study by the participants' overriding desire to put the event behind them and get back to normal: a finding consistent with the cardiac literature [70]. An implication for any technological self-management intervention is sensitivity to the decreasing focus that the cardiac condition, and any subsequent responsibility for change, will have over time.

A source of complementary and conflicting motivations can be found in the context of the individuals' everyday lives. Rather than being motivated by health per se, individuals look forward to spending quality time with their friends and family, or becoming more socially active. As a result of this broader perspective, the individual behaviours themselves become less obviously relevant. Potential conflict arises when activities that contribute towards the quality time that the participants seek, are composed of behaviours that can have negative connotations to health. This conflict of interest has been raised as a problem by others [70], but no suggestions have been made as to whether and how it should be addressed.

We suggest taking a pragmatic approach to speculating about technology's role in addressing conflicts of interest. Rather than subverting competing values, we would suggest designing technology that harnesses any complementary aspects of those values. For example, if an individual is not interested in increasing physical exercise but wants to be around for long enough to see his or her grandchild graduate from college, the benefits of physical activity could be communicated in terms of dexterity and mental agility instead of purely cardiovascular. Additionally, systems that encourage the grandparent to do additional activities with their grandchild may also exploit altruistic motivations.

8.9.3 Implementation: informing and validating behavioural change efforts

Apart from when change is implemented subconsciously, as was done through participation in the cardiac rehabilitation programme, behavioural change depends on the individual considering a particular behaviour to be problematic. During this study we observed how participants placed themselves and their behaviours on a health continuum

when determining whether and how much change was necessary. To do so relies on the self-assessment of behavioural habits, of which there are two well known limitations: firstly people can over- or underestimate frequency of participation [90, 211], and secondly misconceptions of how healthy or unhealthy particular behaviours are can lead a person to underestimate the unhealthiness of their habits [150]. It can be presumed that such misconceptions also lead to similar overestimation, but this is rarely featured as a problem in the health literature. There are several ways in which technology can address these limitations, and automated monitoring is an obvious potential solution to the first limitation of self-assessment—as was illustrated in the Shakra study (see Chapter 4)—and is the subject of much ongoing research (see Chapter 3). Assuming for the moment that automated monitoring of the particular behaviour of concern is technologically possible, we suggest that augmenting the sensed data with clinical and contextual data would enable the individual to make a more informed choice about the need for behavioural change. Clinically, using the two behaviours of concern to this thesis, dietary intake could be presented against nutritional value and nutritional guidelines while physical activity could be presented alongside if and how it contributes to the recommended activity levels. Contextually, an individual's behaviours could be compared to the behaviours of peers, people of varying age groups, gender, and national averages.

As well as being used to inform behavioural change decisions, such augmented monitoring could be presented to the individual in order to help him/her validate current efforts. For those who have integrated additional walks into their daily or weekly routines, it could be used intermittently to verify that they are walking fast or far enough to contribute to their cardiovascular health. For those who are making dietary changes, new foodstuffs could be compared to existing items to verify that the change is nutritionally beneficial.

Similar to the need for prioritisation identified in the previous section, the partialness of changes being made should be accounted for in system designs. For example, if an individual is choosing to focus on reducing salt intake, nutritional systems should reflect that. In the example dietary verification system suggested above, the ranking of nutritional value should be made based on the salt content of the food items. Additional nutritional information should be presented secondarily, to allow for potential developmental exploration and incremental changes.

In consideration of the intermittent focus of participants on behavioural change, we suggest that technology provide a referential service rather than a continuous presence. Essentially,

we propose that technology be used to inform and validate behavioural change efforts. In the same way that participants currently consider the information being provided to them in parallel with their existing behaviours, and then make a decision about what changes to make, so too should technology be a resource that can be consulted if and when the individual so desires.

However, it should be noted that much of the reluctance to continue self-monitoring came from the fact that it had not been deemed necessary by the clinicians. If clinical evidence continues to point to the long-term benefits of self-monitoring [12, 132, 134], clinicians may well start to recommend self-monitoring post-rehabilitation. Given the attitude expressed by the participants regarding clinical advice, it is likely that they would give it a try if so advised.

8.9.4 Collaboration: anticipated support and controlled disclosure

Although experienced to a degree by members of an individual's family, a heart attack happens to the individual and it is the individual who needs to physically recover. We observed two broad categories of social network members found in this study: the inner core group and others. Inner core members were typically immediate family and provided the bulk of support. The distinction within an individual's social network between their inner group and others resonates with the notion of support cliques and sympathy groups discussed by Dunbar et al. [89].

We found that following the event, both the individual and his/her family members undergo a period of uncertainty regarding what is physically safe for the individual to do and what will be possible for the future. In the cardiac literature, this is referred to as the period of adjustment. The supervision and encouragement of the rehabilitation staff, combined with the physical progress that the individuals can see and feel over the course of the rehabilitation programme, serve to increase the individual's confidence with respect to what is physically possible. Family members, however, do not see what the individuals do during the exercise classes and so have to gain confidence by proxy: through verbal reassurance from the individual. As was discussed in Section 8.2, much of the cardiac literature calls for a greater involvement of spouses in the cardiac rehabilitation programme [84, 128, 140, 170]. However, for participants such as those who viewed the rehabilitation as their private battle, the prospect of further involving peers in the process is likely to be frowned upon. Pervasive monitoring could be utilised to convey objective

measures of progress to their peers, in an effort to build peers' confidence, and potentially alleviate unnecessary mollycoddling. Rather than automatically broadcasting progress to the inner core we would suggest that the individual should control information disclosure, as is currently practised.

Although the retention of information was cited as a source of frustration for peers elsewhere [170], controlled and selective disclosure is intrinsic to the maintenance of privacy. It is also especially important when considering the importance of the act of enquiry itself. Alongside interactions elsewhere viewed as controlling and potentially harmful, such as verbal instructions and emotional blackmail [100], enquiries were considered to be a caring gesture; a meaningful expression of concern. If information were automatically broadcast about a person to immediate family, this would reduce the need for him or her to ask how the individual is feeling that day. In other medical situations, such as when a family member is in intensive care the automatic broadcasting of updates may ease the burden of responding to enquiries [175], but here we suggest that it may reduce interactions that contribute to an individual's sense of support. Furthermore, the automatic broadcasting of information may be seen as demanding attention from the family members, something actively avoided by many participants.

As well as the difficulty in finding a balance between acceptable dependency and being a burden, finding a balance between peer involvement and interference is another well-documented source of tension [70, 100, 170, 255]. In contrast to previous work, for the most part we found that individuals were tolerant and even appreciative of potentially intrusive involvement of their family because of an implicit understanding of the underlying motivation behind the family members' actions: caring concern. However, our study was concerned with establishing the response of the individual to peer involvement and we did not measure behavioural outcomes. Given the findings that suggest spousal support contributes to negative health outcomes, perhaps technology could contribute to reducing this area of tension**.** In addition to the earlier suggestion of a system to provide confidence by proxy, technology could also be used to deliver peer-specific rehabilitation programmes that run separately to the individual's programme. In this way peers could benefit from a cardiac rehabilitation programme while the individual retains ownership of their programme.

Similarly, participants appreciated offers of help and assistance even if they did not need to or want to call on those offers. The evident importance of anticipated support supports

findings from gerontology that suggests anticipated support is more valuable to elders than practical support [145]. It is easy to envisage a computer-mediated anticipated support system by which friends and relatives leave virtual post-it notes containing good wishes and offers of assistance, a virtual get well card. However, particularly in view of this population's attitude towards technology, the question that must be asked is what value would such a system add? The vast majority of our participants were happy with their existing levels of support, which, when from people who weren't co-located, came in the form of personal visits, phone calls and emails.

Here we find the crux of the problem when considering the design of peer-based technologies for cardiac rehabilitation. The people who feel that they are well supported do not necessarily need technology to mediate or augment the support processes and structures that they have in place, and clinically there is little to be gained from further enhancing moderate or strong support [13]. For those with weak support structures, it is naive to think that technology can improve what is essentially the nature of their relationships with their peers. Peer-based systems that forge new social ties such as forums may offer some purchase on this problem, but there are limitations in addition to the relative technical and literate expertise required to access and participate in traditional forums. Firstly, when considering the experiences of this study's participants, much of the value of the offers of support and good wishes was in the underlying emotions that they conveyed which are unlikely to be replicated in newly established social ties. One strategy to overcome the limitations of online support would be for portals to point to local community resources as well as relevant online communities.

Lastly, and perhaps more importantly, those who are not used to seeking support may not feel able or willing to proactively search for it. Recall that the two participants with the weakest support structures were the only participants not to engage in discussions with the other rehabilitation participants in their class. Technology can play a limited role in that, as is also suggested in Chapter 7, anonymous and asynchronous communication seems like possible technical strategies to promote the establishment of social ties. However, it is likely that in cases where individuals are unaccustomed to seeking or receiving social support, that such skills may need to be developed independently of any technological intervention. Indeed, Arthur [13] similarly suggests:

> *A pre-requisite for benefit from peer support groups is the availability, and prior use, of social support networks in other aspects of life.*

Before technologists can realistically contribute to increasing the provision of support to those who currently have none, more research is required to understand the nature of support seeking practices of individuals with poor support structures.

8.10 Conclusion

This chapter presented the findings of our study of everyday behavioural change and the issues and factors surrounding peer involvement in cardiac rehabilitation. In the introduction we stated that we were interested in the interplay between the cardiac rehabilitation programme and everyday life, we found a distinction between the two environments in relation to the changes that were made and the involvement of peers. We argued that the fact that it is the individual, rather than the family, who has a heart condition and is attending the rehabilitation programme, leads to a sense of ownership of the rehabilitation and responsibility to recover and implement change. With respect to behavioural change, we found that changes to physical activity levels were embraced and adopted implicitly by enrolment and adherence to the rehabilitation programme. The scope for any additional change (that would be located outsides the constraints of the rehabilitation programme) was then determined by a consideration of health benefits alongside alternative considerations such as enjoyment and impact on lifestyle. This chapter has argued that these observations of distinction have important implications for the design of any technology that is intended for use within this domain.

This chapter argued that the role of self-determination in deciding what behaviours to change and the extent of behavioural change should be respected. Three recommendations can be derived from the discussion in this chapter with respect to self-determination:

- Present prioritised changes in cases where there is the potential to make multiple behavioural changes
- Systems should account for partial changes
- Presented non-prioritised information secondarily, to allow for potential developmental exploration and incremental changes

In relation to the role of self-determination, the chapter argued for a reconsideration of how emerging monitoring technology could be designed in such a way that it offered a potential benefit or service to the individual other than existing goal of motivating change. Two recommendations emerged with respect to the *reorientation of monitoring technology*:

- Augment sensed data with clinical and contextual data to enable the individual to make a more informed choice about the need for behavioural change

- Develop applications to assist an individual in validating his or her existing behavioural change efforts, rather than developing "monitoring systems"

The findings highlighted that an individual's primary focus is not necessarily health or the behavioural change that they are undertaking. The discussion surrounding *shifting focus and competing interests* informs the following recommendations:

- Be sensitive to the decreasing focus that the cardiac condition, and any subsequent sense of responsibility for change, will have over time

- Provide a referential service rather than a continuous presence

- Design technology that harnesses any complementary aspects of competing values, rather than subverting them

The discussion that surrounded peer involvement focused on two particular aspects, namely tension between an individual and their peers, and the provision of social support to those who have none. Instead of suggesting ways in which technology can assist peers in becoming more involved in an individual's rehabilitation, as we had first imagined, we have suggested that technology be designed in such as way so as to build *confidence by proxy*:

- Utilise pervasive monitoring to convey objective measures of progress to their peers to build confidence by proxy

- The individual should control information disclosure, as is currently practised, rather than automatically broadcasting progress

- Deliver peer-specific rehabilitation programmes that run separately to the individual's programme

The chapter argued that the provision of technology facilitated social support to individuals who have weak support structures is more than a matter of simply introducing them to an online support network. Those with weak support structures are those who stand to benefit most from any increase in support, but they are also those whom we know least about. From the findings of this study we cannot offer design guidelines as such, but can offer points for consideration for those intending to further investigate the problem of *supporting the unsupported*:

- It is naive to think that technology can improve what is essentially the nature of their relationships with their peers

- Much of the value of the offers of support and good wishes was in the underlying emotions that they conveyed, which are unlikely to be replicated in newly established social ties

- It is likely that in cases where individuals are unaccustomed to seeking or receiving social support, such skills may need to be developed independently of any technological intervention

In identifying and discussing the problems of peer tension and supporting the unsupported, this study has deconstructed the somewhat abstract notion of social support and provided actionable insights into how technology can contribute and the challenges that may be faced.

This chapter has highlighted the role of self-determination in everyday behavioural change, challenging the notion of the individual as a passive recipient of, and subscriber to, health messages. The process of determining what behaviours to change and the extent of such changes is rarely addressed in the cardiac literature. For the most part failure to implement changes is put down to failed attempts or a lack of social support, rather than discussed as a conscious choice. Therefore, this study provides valuable insight into a currently understudied aspect of health-related behavioural change. When considering the implications of this study for the overall argument of this thesis, this chapter argues that current technological interventions encapsulate the notion of the passive individual. Subsequently, we argue that technology should be designed in such a way that it affords the individual a more active role in the determination and negotiation of health-related behavioural change.

9 Discussion

Having presented the findings of three studies of everyday behavioural change that make up the core of this thesis, the purpose of this chapter is to reflect on those findings. Section 9.1 starts by drawing together the findings of the studies to present an overview of behavioural change that occurs within everyday life as a phenomenon quite different to change that occurs in a behavioural change programme. Put simply, life is not a behavioural change programme. While this may seem like a statement of the obvious to some, the overview serves to illustrate why promoting everyday behavioural change is not a simple matter of raising behavioural awareness or the straightforward porting of traditional behavioural change techniques. In Section 9.2, we revisit the implications for design and research that were presented at the end of each of the study chapters, consider areas of similarity and difference between the study domains, and present new genres of technology that can contribute to this problem space. Finally, in Section 9.3 we reflect on technology's role in promoting behavioural change and outline negotiation as an alternative to persuasion.

9.1 An Overview of Everyday Behavioural Change

Nobody would claim that life is a behavioural change programme. Yet the techniques that have been developed and validated within the constraints of behavioural change programmes are now being employed within everyday health applications. Here we draw

together the findings of the three studies of behavioural change that were presented in the previous three chapters to present an overview of everyday behavioural change. As with any overview there is an unavoidable degree of abstraction and generalisation. The motive in providing this overview is to present the most pertinent points, as informed by the studies in this thesis and as perceived by the author, for consideration when approaching the problem of how to promote everyday behavioural change. It is a quick guide for those unfamiliar with the terrain. The purpose in referencing and comparing everyday behavioural change to a behavioural change programme is partly provocative and partly pragmatic, it provides a useful structure with which to organise our findings.

Fundamental distinctions can be made between an individual's everyday life and a behavioural change programme that relate to social structure and the prioritisation of values. Although not all programmes share the same social structure, they typically include one authority figure and may include a group of peers—as identified by their participation in the programme as individuals also engaging in behavioural change. Without such an authority figure individuals find themselves responsible for identifying and determining a plan of change. Their options are shaped by their exposure to, and experience of, particular strategies, and their access to the resources required to implement change.

When considering the structure of an individual's social network there is a much broader scope of possibilities involving a more diverse range of members than leader and peer: partners, dependants, family, friends, colleagues and neighbours. Given the correlation between social support and health outcomes [52, 66, 123, 233, 246], it is fair to conclude those who are socially isolated are at a disadvantage to those who are not. However, the mere existence of a social network does not mean that members of that social network will encourage or support an individual's efforts to change. Attempts to obstruct change are not necessarily borne out of malice; sometimes they merely reflect conflicting values between the individual and his or her peer. In cases where such disparities exist between an individual and a sizeable proportion of their social network, an individual becomes contextually isolated with respect to their desire to change.

Unlike the relationships formed with leaders and peers in behavioural change programmes, an individual's social network exists before, during, and after change. The relative longevity of relationships within social networks is reflected in the extended scope of potential involvement in an individual's behavioural change. Peer-involvement can be passive or active, intentional or not. Despite the apparent misnomer, we suggest that

passive involvement is the most influential. It is through passive involvement that peer groups construct social norms and frames of reference that are then used by individuals to motivate, drive, and evaluate behavioural change efforts. There are many forms of active involvement: inductive, obstructive, supportive, proactive, and cooperative. Peer-involvement is not limited to engagement in the execution of an individual's behavioural change plans. Peers may not necessarily be aware of their involvement, nor does it always result in a positive contribution (as perceived by the individual).

In the absence of formal roles that govern the rules of engagement in behavioural change, such as the relationship between client and therapist, tensions can exist between the desire for support and the desire for privacy, independence and not wanting to be a burden. Individuals employ a variety of strategies to harness social support from their peers whilst retaining the degree of privacy and independence that they desire. Individuals share aspects of their behavioural change with others, often using common ground to correlate how much they will disclose. The commonality of a condition or concern increases opportunities for collaboration and disclosure. Individuals gradually engage in group activities through a process of incremental participation. In contrast to the relative comparability of those involved, that most frequently governs the degree of selective disclosure, an individual's comfort with him or herself and with the group activity determines an individual's willingness to increase the intensity and visibility of his or her participation. From a peer's perspective, it is ill judged to obstruct efforts to change (obstructive involvement), regardless of any well-meaning intention, although the effect and response to peers suggesting that an individual (inductive involvement) make changes appears to depend on the domain and the clarity of the underlying motivation behind the gesture. There is a fine line between peer involvement being perceived as supportive and as interfering.

Crucially, the shared understanding and common goals of behavioural change are not necessarily present within an individual's social network. Despite the presence of social norms (passive involvement), we do not suggest that individuals are merely sheep who follow each other. Their desires may conflict with the norms of their peer groups, in which case they may decide to 'go it alone'. Individuals can find themselves in contextual isolation for a number of reasons. Genetic predisposition to particular conditions means that an individual may experience medical conditions that are associated with lifestyle choices more readily than their peers who lead comparative lifestyles. Suffering an acute

medical crisis such as a heart attack distinguishes the individual from his or her peers. Although the fact that it has happened may prompt peers to engage in change, the preventative nature of their change differs from the recuperative nature of the individual's. Similarly, life events such as becoming a parent prompt some individuals to reconsider the effects of their behaviour. It is outside the scope of this work to identify the reasons behind the discrepancies in the reaction of individuals to such motivational cues. What is of concern and relevance to this thesis is the recognition that contextual isolation can lead to reduced opportunities for support from peers or reluctance to seek support or increase peer involvement.

Given the situated nature of everyday behavioural change, the values that motivate change from a clinical perspective are not necessarily prioritised in the same way as they are within behavioural change programmes. Health and adherence to behavioural guidelines are considered, if at all, in relation to many other competing interests and constraints such as lifestyle, financial stability, and appearance. Finally, once engaging in change, objective measures of behaviour and progress such as minutes per day, number of portions and BMI, are typically overridden by subjective and intersubjective interpretations of 'enough'.

The relatively simple perspective that behavioural change involves taking on board recommendations and adjusting behaviour accordingly does not account for the complexities of social practice described above. Such an observation prompts us to suggest that everyday health-related behavioural change should be viewed as a matter of compromise; the main elements being clinical guidelines, perceptions of health and health-related behaviours, competing values, resources and self-determination. Taking such a perspective allows us to acknowledge that individuals evaluate recommendations against the competing values and constraints of their everyday life, and then harness the social resources available to them to implement the degree of change that they determine as appropriate. The broader ethical and methodological implications of such an acknowledgement is discussed in Section 9.3. Before that we reflect on the implications for design that were informed by each of the individual studies.

9.2 Revisiting Implications for Research and Design

The discussion that followed each of the studies centred on whether or not current technological approaches fit with the observed practices of everyday behavioural change. As well as the critique of current approaches, the outcomes of the discussions ranged from

specific design suggestions to the identification of new avenues for future research. At the core of the discussions was the question of how to support existing practice, rather than how to correct practice that had deviated from some presupposed ideal of how behavioural change should occur within everyday life. As was discussed in Chapter 5, this reflects the analytic orientation of the author. Others may choose to revisit the findings of these studies from an alternative mindset and derive a different set of implications for research or design than those that were presented in this thesis. For clarity, where previous implications are listed they will be annotated with an acronym that indicates the study from which it was derived: Weight Management (WM), Families at Risk (FAR), or Cardiac Rehabilitation (CR). We have also labelled each of the major recommendation themes to make it easy to reference them in the subsequent section. For example, the reference M1.a.i refers to the first recommendation made in Section 9.2.1.1 below. Section 9.3 discusses alternative perspectives of technology's role in promoting positive health-related behaviours and the ethical implications of each. Here we revisit the implications for research and design that have been presented throughout this thesis and, while maintaining the perspective of how best to support existing practices, identify overarching themes and areas of commonality and diversity.

9.2.1 Motivation

There are three themes with respect to motivation that we will consider here: competing values, the impact of authority, and self-awareness.

9.2.1.1 M1: Competing Values are Inherent to Everyday Life

The overarching theme with respect to motivation throughout all three studies was the presence of competing and sometimes conflicting motivations other than health. In view of these findings, we suggested two possible strategies for technological interventions that aim to increase an individual's motivation to change:

a. Focus on reframing health as a worthy motivation

    i. Challenge common perceptions of health and body image (WM)

    ii. Socially orient systems to have the potential to help people overcome the obstructive perspective that health and health-related behaviours are things that 'other' people do (FAR)

b. Harness complementary aspects of alternative motivations

i. Support transitions in focus between non-health and health-related motivations, goals, and actions (WM)

ii. Be sensitive to the danger of placing an already-pressured caregiver under even more stress, when harnessing the altruistic nature of the caregivers (FAR)

iii. Design technology that harnesses any complementary aspects of competing values, rather than subverting competing values (CR)

The main reason that we did not suggest M1.a as a recommendation for cardiac rehabilitation participants is that we thought it unnecessary for technology to focus on highlighting the importance of health after an individual has just had a heart attack. As was said in Chapter 8, if a heart attack does not motivate change then what chance does a pervasive health application have? (p. 235). However, the benefit of any widespread success of m1.a would inevitably benefit cardiac participants also. The families at risk participants provided an interesting contrast in that they were highly motivated by health, albeit mostly by the health of their children. The tendency for female caregivers to place more importance on the needs of those that they care for is well documented, particularly in the feminist literature [40, 181]. Therefore, female caregiver-specific interventions that highlight the importance of looking after oneself would appear to have a broad potential scope of impact.

Alternatively, as suggested by M1.b, technology could seek to harness complementary aspects of altruistic motivations. The ethical considerations of such interventions were considered at a micro and macro-level in Chapter 7. In addition to risking placing additional strain on already pressured caregivers, harnessing (or exploiting) altruistic motivations also reinforces the priority of the health and needs of others. For some reason, the notion of harnessing the desire of grandparents who want to spend time with their grandchildren seems less exploitative. There is a subtle difference between the two motivations, wanting to spend time with children, and wanting the best for children. Although children obviously benefit from the former, it is less obviously correlated to a child's health or quality of life. A compromise might then be found in the subtleties of any altruistic motivational intervention: rather than focusing on the benefits for the child, focus on presenting the benefits for the individual with regards to their desire to play a positive role in their child's upbringing. Feminist considerations aside, it could also be argued that if an individual is not motivated by their own health yet can be persuaded to change through altruistic reasoning, then any change will subsequently benefit the health of the

individual and so is not exploitative. At the time of writing, the Scottish Executive has recently commenced a mass media social marketing campaign[38] specifically highlighting altruistic motivations and benefits of smoking cessation. From a governmental perspective then, harnessing altruistic motivations appears ethically sound. However, designers of such technological interventions should be aware of the risk of placing caregivers under additional strain.

Possibly more ethically dubious is the prospect of harnessing the appearance-based motivation of the weight-management participants that was suggested in Chapter 6. However distasteful, the same counterargument of eventual benefit presented above could apply here; perhaps even more so given the shift in focus from appearance to health reported by some of the participants. On the other hand, it would be difficult to justify the technological exploration of exploiting peoples' insecurities about their body shape and size, particularly when so much of mass media already does that implicitly and explicitly, with seemingly counterproductive effects. There seems to be an inherent risk of cultivating obsessive attitudes towards weight when emphasising the importance of body image. The argument against appearance-based motivation is further emphasised by the questionable link between BMI and health outcomes [37, 47]. Although obesity is a chronic disease with associated medical complications, research indicates that participation in physical activity is a more significant indicator for health than BMI [68].

9.2.1.2 M2: The Variable Need for Authority and Hierarchy

Each of the studies presented different findings regarding the need for and motivational effect of authority figures. The diversity of findings is reflected in the subsequent implications that were offered in the study chapters:

- Infrastructure should be based on the style of workflow systems for those who appreciate rigidity and discipline (WM)
- Infrastructure should be based on adaptive map-based systems for those who take a more flexible approach (WM)
- Interfaces should provide health messages with a local face and a local voice (FAR)
- Prioritised changes should be presented in cases where there is the potential to make multiple behavioural changes (CR)

[38] See 2.3.3 for a brief overview of social marketing.

Although seemingly disparate, a common theme that runs through each is that of personal relevance. The pervasive nature of weight management as a topic of conversation and concern led to a level of familiarity with- and experience of various weight management strategies such that there was not necessarily a need for authority figures to advise or instruct the individual what to do. In cardiac rehabilitation much of the advice delivered by the rehabilitation staff was a matter of common sense, but a combination of timing and manner of delivery meant that the common sense messages then resonated with the individual and prompted behavioural change. In contrast, with the exception of those who had received input from formal youth programmes, when the families at risk participants had sought help from health professionals, the response had been, if anything, demotivating. The cultural disparity between health professionals and the caregivers and the clinical or generic nature of information provided simply did not resonate with caregivers' needs.

Furthermore, the study populations can be crudely characterised by their stage of change. Here we are not referring to the TTM [199], but rather whether they are pre-change (families at risk), initiating change (cardiac rehabilitation), or in long-term engagement (weight management). By considering the various implications from a temporal perspective, it seems plausible to suggest a combination of these strategies independent from the study domains:

a. For pre-change interventions focus on tailoring health messages to resonate with the social context

b. For interventions aimed to assist those initiating change, prioritised changes and guidance should be offered

c. For interventions aimed to support those in long-term engagement with behavioural change efforts, a less rigid support structure should be offered

It would be difficult to dispute the potential benefit and generalisability of suggestion M2.a. Challenges lie in the subtleties of tailoring interventions to the needs of a specific population. Firstly, how is a population defined? Then, do they share the same needs and perspectives? The study participants, although sharing a particular diagnosis, concern, or socioeconomic status, were far from being homogenous groups. Designing for particular ethnic groups is one approach, as illustrated by [116, 117, 141, 142], but cultures and subcultures are defined by more than just ethnic background [171]. A potential solution would be to approach the problem space from the perspective of community-level models

of health (as discussed in Chapter 2), utilising community-based participatory research methods [173] to develop technological interventions in partnership with community members.

It should be noted that the clinical nature of the cardiac rehabilitation programme and the acute nature of the health crisis that leads up to enrolment on such a programme, leads us to question whether or not M2.b is applicable to less acute behavioural change domains. Incremental changes were deemed a desirable feature for systems that facilitate change in families at risk (discussed further in Section 9.2.2), and so a prioritised change would seem a sensible starting point. The question lies in whether the individual or a clinician, or a clinically informed algorithm, should be responsible for prioritisation? With respect to the families at risk, it was not necessarily the authority figure that was the root of the problem but rather the inappropriate advice that was being given. As has been illustrated throughout this thesis, there is a fine line between assistance and interference. At this point in time we are not in a position to indicate where that line lies, but merely highlight it as an area for consideration when designing interventions or thinking of future avenues of research.

Although derived from the attitudes towards authority figures observed in the weight management study, the integration of workflow and map-based interactions into behavioural change applications also resonates with the transition between phases of the cardiac rehabilitation programme, and the less formal approach to making additional changes to everyday routines and habits. The applicability of M2.c outside the weight management domain is further supported by the reducing focus on health and behavioural change over time that was observed in the cardiac rehabilitation study. The potential benefit of integrating plans of change while allowing for flexibility and manipulation is three-fold: it provides structure for those who need it, while allowing for a more relaxed approach which may prove to be more sustainable in the long-term, and finally it allows for the exploration of alternative and additional changes.

9.2.1.3 M3: Limitations of Behavioural Awareness

As can be seen from the review of current innovations in the field in Chapter 3, much attention has been paid to developing technology to monitor physical activity and dietary intake and subsequent applications rely heavily on the motivational effect of increasing behavioural awareness. Despite self-monitoring being positively correlated with clinical outcomes [134, 241, 254], the studies in this thesis highlighted some important limitations

of self-monitoring health-related behaviours. Again, the details of the resulting implications differ, but they share the common theme of relevance.

a. Design for validation: develop applications to assist an individual in validating his or her existing behavioural change efforts, rather than developing 'monitoring systems' (CR)

b. Design to convey value

    i. Augment monitoring technology to illustrate value of physical activity (WM)

    ii. Augmented sensed data to convey physical and alternative values of physical activity (FAR)

    iii. Augment sensed data with clinical and contextual data to enable the individual to make a more informed choice about the need for behavioural change (CR)

c. Include subjective aspects of weight management, or support interaction that helps individuals express or react to their progress (WM)

d. Design for Action: applications need to be more than just digidyal leaflets, and go beyond raw information provision to support individuals to make changes to their lifestyles (FAR)

For various reasons, behavioural data in isolation was of little value to most of the study participants; weight management participants who monitored their dietary intake being the exception. These suggestions seek to address the gap that exists between raw behavioural data and meaningful information. In designing for validation (M3.a), we recognise that people in general are not interested in being continually monitored or being told what they are doing wrong. Such an approach enables individuals to make informed choices about the behavioural changes they intend to make, and helps them verify that the effort that they are making is not wasted or misplaced.

For those who are unconvinced of the merits of physical activity, otherwise meaningless activity data should be augmented with additional information regarding its contributory status and health, time, calories or cost benefits (M3.b). The underlying motivation is essentially the same as traditional notions of persuasive computing. What is novel about this approach is that it acknowledges and incorporates the competing values found in everyday life (see Section 9.2.1.1) rather than presupposing that health is a priority. The

need for the representation of subjective measures of effort and progress M3.c was highlighted in both the cardiac rehabilitation and the weight management studies.

Arguably, the most important finding with respect to self-awareness was the finding that despite being aware of the limitations of their dietary habits and motivated to make changes out of concern for the health of their children, the majority of the families at risk participants did not have the resources necessary to implement change. This study emphasised the limitations of taking an individual-level approach to behavioural change, both technological and traditional. For this population, it could be argued that focusing efforts on raising self-awareness to increase motivation to change would be unethical without making equivalent efforts to increase opportunity for change (M3.d). This argument resonates with that of health promotion and of community-level models of health and behavioural change, which we will revisit in Section 9.3. For now our discussion remains focussed on practical matters; we continue with a consideration of the implications for technology aiming to assist individuals in the process of implementing change.

9.2.2 Implementation

This section considers ways in which technology can assist in the implementation rather than motivation of behavioural change. The recommendations that were generated from the findings of our studies pointed to ways in which technology could facilitate change, and addressed the nature of support that technology should provide.

9.2.2.1 I1: Facilitating Change by Addressing Barriers

When considering the relatively disadvantaged situation of the families at risk participants, it is unsurprising that most of the recommendations regarding how technology should contribute to change facilitation should be informed by the outstanding needs of this population. However, we do suggest that the recommendations could contribute to the broader population—as will be discussed in the remainder of this section. As can be seen from the categorisations below, we suggest that technology could be applied to three particular barriers to behavioural change: practical and strategic barriers, and lack of opportunity. By lack of opportunity we refer not only to the opportunities for change that currently exist in an individual's life, but also lack of previous exposure to alternative behavioural practices and perspectives of health. An obvious omission to this list is that of perceptual barriers, but they are addressed from a social perspective within the suggestions

to foster social capital in this section, and were addressed from an info-centric perspective in Section 9.2.1.3.

a. Addressing Practical Barriers

    i. Combine exergame and mobile gaming technology to provide weather-appropriate opportunities for physical play (FAR)

    ii. *Or Budgeting, Scheduling, Meal-Planning, Coupon-Shopping*

b. Addressing Strategic Barriers

    i. Systems should help users set realistic and incremental goals, rather than pursuing a complete change of dietary intake (FAR)

    ii. System should assist the user in taking practical steps towards achieving their goals, once goals have been negotiated (FAR)

c. Fostering Opportunities through Social Capital (WM, FAR, CR)

    i. Resource for interaction: socially orient systems to have the potential to overcome the obstructive perspective that health and health-related behaviours are things that other people do (FAR)

    ii. Forging new ties

        - Anonymous and asynchronous communication should be employed to overcome the current socially obstructive issues of trust and lack of time (FAR)

        - It is naive to think that technology can improve what is essentially the nature of their relationships with their peers (CR)

        - It is likely that in cases where individuals are unaccustomed to seeking or receiving social support, such skills may need to be developed independently of any technological intervention (CR)

    iii. Highlight or contribute to community-based resources (FAR, CR)

    iv. Exposure to alternative perspectives

        - Expose individuals to alternative perspectives of physical activity (WM)

        - Exploit positioning technology to highlight opportunities to participate in local activities (WM)

The concern of the families at risk participants about their children's seasonal inactivity led us to suggest that efforts be made to combine exergame and mobile gaming technology in order to provide a season-specific source of physical activity (I1.a.i). Claims of broader applicability are supported by population-wide seasonal activity patterns [192]. Seasonal hybrids are limited in scope to those who are inclined to play computer games. Yet that may not be as delimiting in previous years as a result of the recent success of the Nintendo Wii that has proved appealing to populations not traditionally associated with the computer games [221].

Other practical barriers that were identified throughout the course of this these included financial constraints (FAR), and a lack of time (FAR, CR, WM). Although no particular design suggestions were offered within the corresponding study chapters, there is no reason why technologists should not consider how to design to address such practical barriers to change (I1.a.ii). The pervasiveness of these barriers throughout the public health literature [35, 178] would suggest that they are indeed worthwhile avenues of future exploration. Indeed, the technological answer to this particular problem area may well already exist in the form of budgeting and scheduling software, although it is likely that they would need to be integrated into population-appropriate applications. We can also draw inspiration from the strategies that some families at risk participants had already devised to make the most of their time or money: meal planning and coupon shopping. Meal planning applications that minimise the amount of food wastage from the weekly shop, an opportunistic recipe guide could also suggest recipes based on remaining items, and a coupon shopping application could highlight the special offers that are available at local stores.

Budgeting, scheduling and meal planning are all skills that can be learnt. When considering the design of skill-based applications, some thought should be paid to whether the application should perform the task, teach the user how to perform the task, or a combination of the two. As with any design decision, there are benefits and disadvantages associated with each alternative (see Table 9-1).

Format	Advantage	Disadvantage
Tutoring	Teaches a skill for life	High demand on user
Automated	Low demand on user	Fosters a dependency on technology
Hybrid	Allows a user to explore and engage with a task at their own pace	Technologically Complex

Table 9-1: Advantages and Disadvantages of Tutoring, Automated, and Hybrid Skill-Based Applications

Essentially, a tutoring system has the potential to teach individuals a skill for life that they will be able to perform independently of any technological platform. This is important for those who may have sporadic access to technology for financial reasons, or for those who prefer not to rely on technology for tasks that they could otherwise do themselves. The drawback of tutoring systems is that they place relatively high demands on the user: time, commitment to learn, cognitive ability to learn. Automated systems on the other hand place relatively low demands on the user, but foster a dependency on the application for the task to be completed. However, it could be the case that once an individual has established a routine that has been informed by the application that he or she no longer needs to perform the said task. For example, as would be the case for a scheduling system that helps an individual find time for a weekly walk. The benefit of a hybrid system is that it would allow an individual to gradually explore and engage with a task at his or her own pace. The potential drawback of a system is that the complexity involved in such an adaptive system may prove to be off putting or even prohibitive for populations who are not comfortable using technology. There is a similar trade-off to be made here, as was observed in the convenience-accuracy trade off in sensing technologies that was highlighted in Chapter 3. As we suggested then, we suggest here that it is unlikely that there is one gold standard that is appropriate for all systems and contexts of use, and more research is required to establish where each appropriate trade off lies.

The design suggestions offered above, while addressing the practical barriers to positive health-related behaviours that were observed in this thesis, need not necessarily reference the behaviours themselves. The second recommendation, designing to deal with strategic barriers to health-related behavioural change (I1.b), explicitly considers the problems of implementing behavioural change. Again, it was the families at risk study that sensitised us to the importance of having a strategy to implement change. It is not enough to simply want to change; an individual needs to know how to go about implementing change. This was found to be of particular relevance to the problem of improving dietary intake. Problems ranged from converting nutritional guidelines into meaningful and actionable advice, to successfully introducing new foods to a child. When considering the formal guidance provided by the cardiac rehabilitation programme and the common knowledge shared between peers in the weight management study, the families at risk participants benefitted from neither. As was discussed in Section 9.2.1.2, the sources of information that were widely available to the population did not resonate with the population. There are

many potential ways in which strategy could be included in technological interventions; these are presented within a broader discussion of the nature of support in Section 9.2.2.2.

In addition to providing strategies for an individual to follow, an alternative approach would be to foster the opportunity for individuals to engage in discussions about health, and benefit from shared experience and common knowledge, thus enabling them to develop their own strategies. This is just one example of how an individual's social capital contributes to his or her ability or opportunity to implement change. Each of the studies illustrated different aspects of social capital; the implications of the various forms of peer involvement are discussed further in Section 9.2.3. Here we focus on how technology can promote opportunities for change (I1.c), by fostering the development of health-related social capital. Of all of the suggestions made so far, this is perhaps the most indirect approach. This thesis pointed to three particular forms of social capital to which technology can or should contribute.

The potential for lightweight social awareness applications to create resources for interaction around health and wellbeing (I1.c.i) was initially identified during the review of current approaches to promoting everyday behavioural change (Chapter 3) and further emphasised by the findings of the pilot study of Shakra (Chapter 4). We later suggested that creating such resources for interaction would benefit the Families at Risk participants who had commented that health and health-related behaviours were not a topic of conversation within their social networks despite the concern that most participants expressed during their interviews (Chapter 7). We did not establish during the interviews why it was that participants did not raise their concerns with their social networks. It may be that they simply did not want to talk about it, or that the feeling of helplessness that they had expressed precluded any inclination to talk about it, that they think that their peers are not interested. The benefit of creating resources for health-related interactions is that no one individual is then responsible for breaking social norms and bringing up the topic of health. In populations whereby such latent concerns may not be present, they serve to increase the profile of health. The motivation behind such suggestions is the assumption that by making health and health-related behaviours a topic of everyday conversation, people are more likely to engage in collaborative sense making. This argument was illustrated in part by the everyday and collaborative nature of weight management described in Chapter 6.

The notion of creating resources for interaction does presuppose an existing social network, which, as we saw in both the families at risk and cardiac rehabilitation studies, is not always applicable. For those who have no existing social network or an unsupportive social network, computer mediated social capital may serve a most basic function of forging social network ties (I1.c.ii). The challenges and limitations of online support were presented in Chapter 8.9.4. However, the severe implications of isolation were also discussed.

One of the suggestions we offered to overcome the limitations of online support was to incorporate community-based resources in the design of online resources (Chapter 6). In a similar vein, as a result of the isolation that was observed within the families at risk study, we also suggested that technology be developed in such a way that it promotes interaction within a community (Chapter 7). The application of technology to highlight or contribute to community resources (I1.c.iii) marks a move towards a community-level approach to health that was introduced in Chapter 2. Community-based resources have already been highlighted as a suitable medium for pre-change interventions that focus on tailoring health messages to resonate with the social context (Section 9.2.1.2, p. 252). Here we suggest that they can provide community members with a means to develop their own social capital that may subsequently let them better their quality of life, be it through making individual behavioural change, collaborative change, or lobbying for environmental or political change and better service provision.

As was said in Section 2.3.3, community models of health emphasise the need for the prioritisation of issues and problems as perceived by the community, rather than external agencies. While the findings of the families at risk study point to potential areas of prioritisation for that community, it is not possible to speculate what issues and problems would be perceived and prioritised in other communities. Although the basic infrastructure could be designed in advance or follow a generic pattern, such resources would have to be developed in partnership with the communities in which they are intended to be deployed through participatory methods such as community-based participatory research [173]. As with the hospital volunteer service discussed in Chapter 8.2, such resources rely on a corpus of motivated individuals with free time to participate.

Throughout all of the studies that have been included in this thesis, we have recognised that an individual's exposure to, and experience of, particular behaviours, influences their perception of, and participation in, related behaviours. While the suggestions offered in

Section 9.2.1.3 addressed perceptions by striving to convey the multiple values of particular behaviours, an alternative approach is to use technology as a lens through which to view alternative perspectives of health and health-related behaviours (I1.c.iv). To borrow a phrase from Chapter 6, if we are not introduced to sports at school that we enjoy then when or how are we? The motivation behind such a suggestion is the observation that our opportunities for exposure to new behaviours and alternative perspectives is somewhat constrained by the scope that is afforded by our social network, or our social capital. Similarly, if we do not know anyone in our situation that has successfully implemented change then we cannot benefit from his or her experience (as was found in Chapter 7). If we recognise the influence and limitations of our history and our current situation, then the limitations of any decisions that are made regarding our health and health-related behaviours also become apparent. There is evidence from each of the studies to support the need for such exposure to alternatives. Therefore, it is suggested that this approach may be of benefit to the broader population. We argue that technology is ideally suited to providing such exposure, and via technology, such as awareness tools and recommendation systems, presenting the alternative lifestyles of people who are similar, or were similar, increases the likelihood of resonance and self-referent encoding. By providing such exposure to alternatives, we compensate for the limited opportunities that may currently exist in everyday life. In contrast to traditional approaches aimed at persuading an individual to adopt a particular behaviour, here we recognise that individuals have the right to choose whether or not to implement change. The overall aim of exposing individuals to alternative perspectives is to ensure that the decision the individual makes is as well informed as possible, and less constrained by the limitations of his or her experience and circumstance.

When considering all of the recommendations, technologically facilitated social capital may seem the most abstract, the link between with health and health-related behavioural outcomes being less obvious than persuading behavioural change, for example. However, Carpiano's [57] conceptual framework of neighbourhood social capital, that was presented in Chapter 2, suggests four health-determining forms of social capital: social support, social leverage, informal social control, and community organisation participation. Although yet to be validated, the strong link between social support and health that has been cited throughout this thesis certainly supports the merit of further investigating the development of technologically facilitated social capital. Such studies are critically needed

if social capital-based health interventions are to be formalised. Until then, social capital theories can be used to inform and inspire more exploratory undertakings.

9.2.2.2 I2: Assistive Support rather than Directive Intervention

The preceding sections have possibly already conveyed the overall argument of this section: that technology should be designed in such a way that it assists, rather than directs, change. When contemplating ways in which technology can be assistive rather than directive, the findings of our studies point to the determination of extent of change to be worthy of consideration.

a. Allow for partial change (FAR, CR)

b. Allow for incremental change (FAR, CR)

The suggestions of allowing for partial (I2.a) and incremental (I2.b) changes emerged from the cardiac rehabilitation and families at risk studies for very different reasons. In the families at risk study, they were suggested in recognition of the socioeconomic constraints that limited participants' behavioural change efforts. Allowing for partial change recognises the potential limitations of individuals' resources and addresses the problem of individuals feeling overwhelmed by the size of the task. Fogg [98] also identifies reduction as a strategy for persuading change:

> *Using computing technology to reduce complex behavior to simple tasks increases the benefit/cost ratio of the behavior and influences users to perform the behavior.*

In contrast, informed choice was much more evident within the cardiac rehabilitation study (albeit subject to the limitations discussed in the previous section). Participants were aware of the strengths and weaknesses of their health-related behaviours, and decided the extent of desired behavioural change rather than aiming for complete behavioural change. Unlike the use of reduction as a persuasive strategy, we suggest that partial changes be integrated into systems in recognition of the role of self-determination in behavioural change.

Despite the above distinction between the two populations, we do not suggest that resources for change were not limited for the cardiac rehabilitation or weight management participants. We make the point that resources were not the overriding determining factor in the same way as it was for the families at risk participants. Regardless of the reason

behind the need for partiality, it appears to be a sensible feature to include in any application that aims to support the implementation of behavioural change efforts. Incremental changes were suggested in both so as not to restrict further opportunity for change, instead leaving the option open for gradual engagement and exploration of further possibilities.

9.2.3 Collaboration

The social nature of health and health-related behaviours has been evident throughout the thesis and this chapter so far. This section reconsiders the scope, mechanics and challenges of developing technology for collaboration around health-related behavioural change.

9.2.3.1 C1: The Scope of Peer Involvement

Explained in part by the everyday nature of weight management as opposed to the acute health crisis of a cardiac event, or the unspoken concerns of families at risk, the broadest scope of peer involvement in behavioural change was observed during the weight management study. When considering peer-involvement in health-related behavioural change, this section addresses 'the who' and 'the what'. The following section considers the mechanics of peer involvement—'the how'.

a. Develop applications that support or emulate the various passive and active forms of peer involvement (WM)

b. Consider the characteristics of the target population:

    i. Develop gender-sensitive applications (WM, FAR, CR)

        - Gender-based interactions (WM)

        - Gender-specific interventions (FAR, CR)

    ii. Consider the subgroup of peer who the system is intended to involve (WM, FAR, CR)

As well as indicating situations or contexts where the lightweight awareness applications that were reviewed in Chapter 3 are appropriate, the various forms of peer involvement

that we observed in the weight management study serve as inspiration for alternative approaches to harnessing social influence (C1.a). See Section 6.6 for categorisations of peer involvement and Table 6-3 in Section 6.7.3 for examples of how each form could be supported. Although the categorisations of peer involvement were derived from the weight management study, they are concepts that could easily be applied to other domains. However, as was indicated in Section 9.1, we should avoid jumping to conclusions about the benefit or disadvantage of such peer involvement in different contexts. For example, while inductive involvement was found to be ineffective within weight management for any purpose other than making an individual feel bad, within cardiac rehabilitation it had proved to be a stimulant for behavioural change. Similarly, anticipated support was not observed in any of the studies apart from cardiac rehabilitation, so it is not possible to speculate if the same associated importance would hold in the other domains. It is easy to imagine that knowing that people were there to help if they were needed would be of great value to the families at risk participants, but for some reason its potential value to weight management participants is not as obvious. Nevertheless, by being aware of the various forms of peer involvement that have been observed during this thesis, technologists are better equipped to explore the scope for technological support or emulation of such involvement.

Although the intricacies of individuals' social networks vary greatly, patterns did emerge with respect to who was actively involved in behavioural change efforts. Gender-based practices were evident in the weight management study, and although the dominance of one particular gender in each of the remaining studies prevented any gender-based conclusions being drawn, findings did support traditional notions of gendered behaviour. This led to the suggestions that gender-sensitive interventions be developed (C1.b.i), the subtleties of each suggestion differing for each domain. For weight management we cautioned reinforcing gender stereotypes and suggested gender-balanced interventions, while the families at risk study prompted us to recommend interventions that promote self-care in female caregivers who traditionally neglect their own needs in favour of their families'. There are direct and indirect means by which to address this issue. Indirectly, technology could emphasis the overall importance for women to take care of themselves by developing female-specific applications, such as Houston [72]. In order to address the issue directly, female-caregiver-specific interventions would be required. When considering the existing priority that caregivers' place on the cared-for, it may be necessary to approach this problem from within existing resources that caregivers use

when helping or seeking support for the cared for. Otherwise, why would a caregiver use with low investment in self be using a caregiver-specific intervention? Examples of how to engage caregivers with caregiver-specific interventions are:

- On websites that are relevant to caregivers, such as financial aid and parenting or condition-specific sites, place a link to:
    - A website or application containing motivational material (regarding self-worth rather than particular health-related behaviours)
- In interventions designed to benefit the cared-for, either behavioural change or therapeutic, include a 'what about you?'[39] prompt aimed at the caregiver. The aim being not to increase burden but to prompt reflection on own wellbeing.

In view of the gender imbalances associated with cardiac rehabilitation recruitment (which was touched on in Chapter 8), such interventions are also likely to benefit female cardiac patients.

In addition to gender-based practices, peer 'type' also distinguished patterns of peer involvement. Distinguishable types were spouses, dependents, collocated or immediate family, extended family, and friends and colleagues. In the same way that we urge technologists to consider what form of peer involvement they aim to support, here we suggest that they explicitly consider what subgroup of peers they wish to include within the design of a system (C1.b.ii). The individual design suggestions that were offered at the end of the weight management and cardiac rehabilitation study highlight the differences between the two domains. In weight management, a relative lack of family involvement prompted the suggestion that efforts be made to develop a family-based system to raise family awareness and prompt or challenge family members to help out. In cardiac rehabilitation, the tension between involvement and interference was recognised and the recommendation was made that systems be developed to allow the individuals to convey their progress and capabilities to their family members and that family specific interventions be developed in parallel to those focusing on the needs of the individual. Again, we do not make claims of generalisation across domains but merely raise the issue of peer type as a design decision.

[39] "What about you?" should not be taken as a literal design suggestion, but should be considered to be placeholder for a more nuanced interaction.

A final consideration that was raised by each of the studies to varying degrees is that we cannot presume that an individual has a social network or that a social network is supportive of behavioural change. We have referred to these situations as social and contextual isolation respectively; contextual isolation also referring to the disparity that is introduced to a relationship when one individual has a cardiac condition or is overweight etc., and the other is not. Various strategies have been identified already, ranging from increasing social capital (Section 9.2.2.1), to ameliorating the context gap between an individual and their peers (above). The challenges of addressing the limitations of an individual's peer group are discussed in Section 9.2.3.3. Next we focus on the mechanics of collaboration; in particular how individuals harness social support while maintaining their privacy.

9.2.3.2 C2: The Mechanics of Harnessing Social Support

One of the initial motivations behind the work in this thesis was the suspicion that the existing approach to harnessing social influence in everyday behavioural change applications did not account for the subtleties or complexities of interpersonal relationships. The subsequent studies did indeed confirm that harnessing social support and collaboration around behavioural change was more than a matter of broadcasting behavioural data between predefined peers. The recommendations for more sophisticated modes of interaction were informed by the existing information disclosure practices of the weight management and cardiac rehabilitation participants.

a. Facilitate selective disclosure

    i. Automatic implementation of selective disclosure should be based on the relative comparability of individuals and their weight management (WM)

    ii. Allow the individual to control information disclosure, as is currently practised, rather than automatically broadcasting progress (CR)

b. Facilitate incremental participation in group-based designs (WM)

Despite playing such an influential role in steering the course of this thesis, with respect to any extended discussion on the findings and subsequent implications for design there is relatively little to say. Arguably the least contentious of our findings, the findings provide a model for interaction within peer-based applications. The parallels that can be drawn between our findings and more established understandings of social interaction, such as

those between incremental participation and Lave and Wenger's [149] legitimate peripheral participation, between relative comparability and Festinger's [96] social comparison theory, and between prompted disclosure and the role of asymmetry and control in relationships between elders and their offspring [154], point toward the broader applicability of our suggestions.

The question of whether or not the existing information disclosure practices of individuals should be emulated has not yet been raised in this thesis. The introduction of technology inevitably changes social practices and, as the Shakra pilot study illustrated (Chapter 4), people are more than capable of appropriating systems for use. What is to be gained by seeking to mirror existing practices? As has been found in many studies of online communities, the most basic form of interaction—text-based asynchronous comms—has proved to be preferable to more technically sophisticated equivalents [31, 95, 161]. When considering the control of information, the most basic option would be to retain the current approach of straightforward broadcasting. That way, if an individual would simply need to cease using the application if he or she no longer wanted to share that information. To encourage continuing use we suggest that a more sophisticated approach is required.

The traditional approach to enabling user control over privacy settings is to provide access control lists that facilitate the manual allocation of privacy and permissions to individuals and subgroups [28, 105, 225]. However, not only can this task become a burden to the user [203], they are prone to simply forgetting updating changes in status [182]. Secondly, Godefroid et al. [108] highlight the complexity of developing comprehensive privacy policies in presence awareness systems; they offer an automated approach to verifying privacy policies, but do not address the difficulties inherent in developing them in the first place.

More recent efforts borrow the notion of proximity that is often employed spatially within collaborative virtual environments as a determinant of access to resources [29]. Goecks and Mynatt [109] combine predetermined privacy levels and sharing policies with the proximity of another person within an individual's social network, thus reducing the granularity of manual declaration required while the policies aim to permit more naturalistic sharing of data. Sherwood [220] advocates an alternative notion of social proximity as a strategy for impression management on social networking sites. Similarity in interests and activities are measured, and an individual's social networking site is automatically tailored to the person who is viewing it. Feedback and control, the core

strategies to deal with the reduced mutual awareness that is inherent in computer mediated communication [28], is supported by allowing the individual to see the tailored presentation as well as manually make adjustments to the presentation and logged data.

The purpose of this brief visit to the CSCW literature was not to speculate on how to implement our suggestions, but to highlight the tension between user control of information disclosure and complexity of system design. Indeed, Ackerman [1] uses the issue of privacy is a demonstration of what he calls the social-technical gap between "what we know we *must* support socially and what we *can* support technically". In a similar manner to our earlier observations of the trade off between convenience and accuracy faced by those designing self-monitoring technologies (Chapter 3), more research is required to determine where the acceptable boundaries lie with respect to complexity and control.

9.2.3.3 C3: Limitations of Computer Mediated Social Support Interventions

In addition to the technical challenges discussed above, there are also challenges of a non-technical nature to be considered when designing for collaboration. The importance of social support and our observations of social isolation prompted us to suggest that efforts be made to create technology to foster social capital (see Section 9.2.2.1). We recognised that the same issues that contributed to an individual's social isolation may also contribute negatively to the likelihood that the individual would use such a service. While we were able to suggest technological strategies to ameliorate issues of trust (C3.a), the problem of teaching individuals the social skills necessary to seek and accept support (C3.b) is less easily addressed by technology.

a. Anonymous and asynchronous communication should be employed to overcome the current socially obstructive issues of trust and lack of time (FAR, CR)

b. In cases where individuals are unaccustomed to seeking or receiving social support, such skills may need to be developed independently of any technological intervention (CR)

As was indicated in the earlier discussion relating to community-based social capital, we call for a realistic view of how much technology can contribute to this problem space. It could be argued that there is already technology 'out there' that can provide isolated individuals with a support network in the form of online support groups and forums. However, there was no evidence of the participants who stood to gain most from additional

support having used them or sought them out. In addition to our observation that those with little support were not accustomed to seeking help or did not want to ask for help, there are many reasons as to why people do not seek support online: many of our participants hadn't heard of forums or didn't associate the Internet with such activities.

As much as there is a limitation to what technology can achieve there is also a limitation to what technologists are responsible for. We acknowledge that socioeconomic inequalities cannot drive technical innovation, but we suggest that technologists remain sensitive to the potential discrepancy in social skills of potential users; particularly when designing technologies to provide support for the unsupported.

9.3 Rethinking Technology's Role: From Persuasion to Negotiation

Health-related behavioural change is a relatively new area of interest within HCI and associated communities. Many innovative and engaging applications have emerged that prompt reflection on, and encourage participation in, positive health-related behaviours. However, this thesis has argued that current approaches are limited in scope by some of the implicit assumptions and values that they embody. In the previous section, an analysis of the design critiques and research directions offered by the individual study chapters' highlighted areas of scope, opportunity, and challenge. This section takes a step back from individual instantiations to present an analysis of the values embodied in existing approaches, to consider the role that technology has assumed in this domain and consider alternative approaches.

As was first mentioned in Chapter 1, we suggest that everyday behavioural change technology so far encapsulates the traditional clinical perspective of health-related behaviour and health-related behavioural change. Given the clinical roots of health-related behavioural change, this dominance is unsurprising. When we refer to the clinical perspective of health-related behaviour and behavioural change, we refer to:

- The promotion of adherence to national and international guidelines that offer quite extensive recommendations as to the kind of behaviours we should be participating in if we are to increase or maintain our health and reduce the risk of particular diseases

- The adoption of individual-level models of behavioural change evident in the focus on the individual's responsibility to change

- The hierarchy that is inferred by the receptive (or passive) role of the individual

We suggest that the limitations of technological approaches that have been suggested throughout this thesis are not unique to technological innovations, but are merely symptomatic of the limitations associated with the clinical approach that were highlighted during the review of the sociomedical literature that was presented in Chapter 2. As just mentioned, it is understandable that technologists would seek inspiration or methodological guidance from the clinical domain. However, we would argue that technologists are in a position to benefit from the successes *and* failures of the traditional approach. That is, technologists should seek to avoid making the same mistakes twice. After many years of domination by the medical model of health, alternative perspectives of health are gaining credibility and acceptance. It would seem something of a wasted opportunity if technological efforts did not reflect more contemporary understandings of the problem space. It should be noted that we do not imply that the traditional approach is an area unworthy of future research, nor do we seek to discredit current work in the area. Rather, we argue that the limitations of such an approach should be acknowledged.

In view of the aforementioned limitations, we now consider the question of what is to be done. Section 9.2 discussed the main implications for design that emerged from the three studies that form the core of this thesis. On a more conceptual level, what the implications represent and what this thesis argues for is a move from the persuasive paradigm to one of negotiation. Rather than focusing on persuading individuals to adopt the behaviours that others—be they clinicians or system designers—say they should, we suggest that technology should engage in negotiation with the individuals to help them explore their options and make informed decisions, while providing opportunities and resources for change.

Throughout this thesis we have drawn parallels between persuasive technology and theories of behavioural change. In contrast, as may have been evident in the previous chapters and as will be made more explicit in the coming sections, in negotiation we seek to embody the principles of health promotion. Chapter 2.3 discussed the differences between behavioural change and health promotion. Obviously behavioural change may well occur within the scope of health promotion, but the crucial difference is that health promotion's overall aim of "enabling people to increase control over, and to improve, their health" [256]. We will revisit the implications of taking such an approach later, first we

will continue outlining our argument for negotiation, shifting the focus from behavioural change to everyday health promotion.

It is understandable that within the context of a person's everyday life, there are motivations and values other than health that compete and commonly take priority. As we have seen throughout this thesis, life is not a behavioural change programme, and ultimately people want to enjoy their lives; be it by eating particular food or participating in pastimes that they enjoy. People are free to make these decisions, and as long as people are aware of the consequences of their actions people should be free to choose whether or not to change. It is their lives after all. This is why we argue that technology should engage in negotiation rather than persuasion. There has to be some give and take.

Theories of negotiation have been developed from within many fields, the four main strands being economics, decision and game theory, social psychology and psychology [208]. For the purpose of this thesis, in the proposal of negotiation as a viable avenue of research within this problem domain, we refer to the definition and principles of negotiation as identified by Rojot [208]. As with many texts on negotiation, Rojot approaches the subject from an organisational and managerial perspective. However, as will become evident, the overarching themes and concepts resonate with many of the findings and discussions that have been presented in this thesis.

At the core of negotiation is the concept of conflict—negotiation being a matter of conflict resolution. Before we consider the intricacies of negotiation, let us first consider the meaning of conflict and its relation to the topic of this thesis:

> *The potential for conflict is present everywhere. It is particularly visible in organised situations, although it is also very often present in informal, chance happenings.*
> *As soon as there are two individuals in contact […] there is almost always a* ***divergence of opinion****, a* ***variety of vested interests****, of* ***differing beliefs*** *involved.*[40] *[208]*

The problem of promoting health-related behavioural change is a matter of conflict between the values and recommendations of clinicians and governments, and the values and desires of the general public. The traditional approaches to promoting behavioural change that have been discussed within this thesis aim to realign the opinions, interests, beliefs, and subsequently practices of the individual with those of the establishment.

[40] Emphasis added.

Negotiation, on the other hand, rejects implicit assumptions or authority of a 'one best way' and instead focuses on managing, channelling or containing conflict that is "present and unavoidable in most, if not all, social situations and interactions" [208]. Terminology such as managing, channelling and containing is intrinsically linked to the managerial perspective and does not necessarily fit naturally with the argument against a hierarchic approach to promoting health-related behaviours. However, Rojot's justifications for rejecting the notion of a 'one best way' are evident in the observations and arguments that have been made in this thesis. Put briefly, he argues that individuals are rational beings and therefore:

> *The simple scheme—one applies the correct stimulus […] and then people are motivated, then act according to plan—is erroneous.*

Resonating with our observations that individuals make behavioural choices based on their exposure and experience, Rojot also refers to the concept of bounded rationality, whereby the rationality of individual's is limited by their experience:

> *Within the framework of their limited knowledge, capacities, and means of action, they are going to try and select a preferred alternative. Therefore they are not irrational, but their rationality is limited, bounded.*

In addition to the acknowledgement that everybody behaves rationally in their own eyes, it also sensitises us to the fact that parties entering into negotiation may not share a common frame of reference [208]. These observations led Rojot to conclude that:

> *Persuasion, the action of talking somebody into a change of attitude through logical reasoning will very often not work in negotiating. Clearly, this is because, however logical or rational and clear is our reasoning, for ourselves, our logic will not work to persuade somebody to step out of the bonds of his own rationality and logic.*

This thesis is not the first to propose negotiation as an alternative to persuasion with respect to health-related behaviours. A brief form of motivational interviewing was put forward in 1992 as a method for health professionals to engage patients in reflective discussions [209]. The need for a new approach was prompted by the limitation of traditional approaches:

> *One problem about giving advice about behaviour is that many patients are not ready to change when they enter the consultation […] More fundamental is*

> *the possibility that direct persuasion per se, whatever the degree of readiness to change, pushes the patient into a position of defensiveness.*

Adapted from techniques developed in the addiction field, Rollnick et al. [209] take a similar stage-based approach to that advocated by the Transtheoretical Model of behavioural change [199], emphasising the importance of tailoring interactions to the perspective of the individual. The overall goal of motivational interviewing is to:

> *Explore [the conflict between indulgence and restraint] and to encourage patients to express their reasons for concern and the arguments for change. The interviewer's role is simply to elicit this material, thereby building motivation in a more constructive way. The interviewer does not argue in favour of change or restraint, but rather helps patients do this for themselves.*

Tyler and Horner [243] have developed a family-centred collaborative negotiation model for facilitation of behavioural change that combines the brief motivational interviewing technique [209] with the Touchpoint model of care. Based on an understanding of the predictable times in a child's development that raises challenges for the child and the family unit, alongside guiding principles and assumptions regarding the parent, the health professional, and the nature of the relationship between them, "the Touchpoint model shifts away from the objective prescriptive approach to a more empathetic and collaborative partnership." [243] Resonating somewhat with the argument of this thesis, an emphasis of the collaborative negotiation model is the prioritisation of health concerns that are defined through discussion between the health professional and the family, rather than the imposition of predetermined goals and outcomes.

9.3.1 Negotiation as a Model of Interaction

In the previous examples negotiation is achieved through empathetic and non-hierarchic interactions and dialogue between a health professional and the individual. Strategies include open questioning, prompting reflection, information exchange and collaborative goal setting. It is feasible that technology could be designed in such a way that it emulates and facilitates such interactions and reflection, using the process of verbal negotiation as a model for interaction between the system and the individual.

For example, Embodied Conversational Agents (ECAs) have been developed that engage in persuasive dialogue with an individual to persuade physical activity-related behavioural and attitudinal change [32, 213]. In their work evaluating the effect of social dialogue on

the effectiveness of embodied and text-based agents Schulman and Bickmore [213] describe the persuasive dialogue of the agents as:

> *[arguing] for the importance of statements about the advantages of regular exercise, and against statements which emphasize the disadvantages. Positive statements referenced advantages including health benefits and stress reduction, while negative statements mentioned time requirements and complication.*

Negotiation could be used as an alternative model of interaction for such agents, both embodied and text-based. Indeed, Schulman and Bickmore [213] have recently identified motivational interviewing as an avenue of future research in ECAs. Instead of countering negative statements with positive ones in order to persuade the individual to change, a negotiating ECA would embody motivational interviewing's strategies to promote reflection on the arguments in favour of change or restraint.

However, the level of engagement that ECAs demand leads to one of the limitations of existing approaches also applying here. Namely, that to engage directly with a conversational agent about health-related behaviours and behavioural change requires a degree of existing interest or engagement. Additionally, when we consider the participants' resistance to being told what to do, and the reluctance to engage in self-monitoring or use technology unless instructed to as part of a formal programme of care or change, even negotiating ECAs appear to be less suited to everyday behavioural change and more appropriate for use in formal domains such as clinical or educational settings. One exception to this statement (from the studies included in this thesis) may prove to be in persuading or negotiating changes to children's dietary intake, whereby we assume that children may be more receptive to entering into dialogue and engaging with an ECA.

Furthermore, given the importance of competing and conflicting values that has been observed throughout the studies in this thesis, we suggest that it is imperative that such interventions be able to address issues other than just attitudes relating directly to the benefit or disadvantage of a particular health-related behaviour. Examples of more holistic interventions inspired by the work in this thesis would be:

- An ECA that promotes the need to self-care within populations of female caregivers

- An ECA that takes as its parameters factors such as responsibilities, interests, taste and enjoyment, in addition to health and health-related behaviours

At the most basic level then, negotiation could be considered to be a model for interaction. However, the examples that have been presented above resonate somewhat with the existing approach of focussing on the motivation of the individual. While a collaborative dialogue could be envisaged that would allow families or communities to collectively explore reasons and barriers to change, we would argue that technology has the potential to bring much more to negotiation than simulated patterns of interaction.

What technology can and maybe should focus on is highlighting alternatives and providing opportunities so that the decisions that people make are better informed, whatever those decisions may be. Once committed to change, technology could help equip the individual for change. In addition to the impact of resources on an individual's ability to implement changes, the desire to change is also influenced by the perception of what is enjoyable; his or her behaviour and perceptions being physiologically and socially grounded. While there is little that everyday health technology can do to address physiological predisposition, it could play a part in the social construction of what is 'enjoyable' and, with respect to competing values, what is important. Section 9.2 has suggested some ways in which technology might contribute, but these are just starting points. Such an approach respects the fact that people have the right not to change, but seeks to ensure that the decisions they make are as informed as possible and not constrained by their own experience.

9.3.2 Negotiation as a Framework for Sociotechnical Interventions

The suggestion above was inspired by the findings of the studies presented in this thesis, and subsequently inspired the notion of negotiation as a promising paradigm for everyday health applications. However, when thinking of alternative ways of encapsulating or facilitating negotiation with technology, or when considering how to further develop or define the paradigm, a systematic approach is required; for this we return to Rojot [208]. According to Rojot:

> *A negotiation is structured by the relationship between **the parties**, the resources and constraints within **the environment** and **bargaining power**.*[41]

[41] Emphasis added.

Although not its intended use, this framework provides a useful point of reference for technologists and researchers unfamiliar with the theoretical underpinnings of negotiation. An awareness of the role and interplay of the individual elements, and then of the elements' attributes, suddenly opens up a landscape of possibilities and considerations. For a detailed description of the structural features of negotiation we refer the reader to [208]. Here we provide a brief overview (as illustrated in Figure 9-1 overleaf) and focus on aspects that serve a discussion of the implication for technological ventures in this domain.

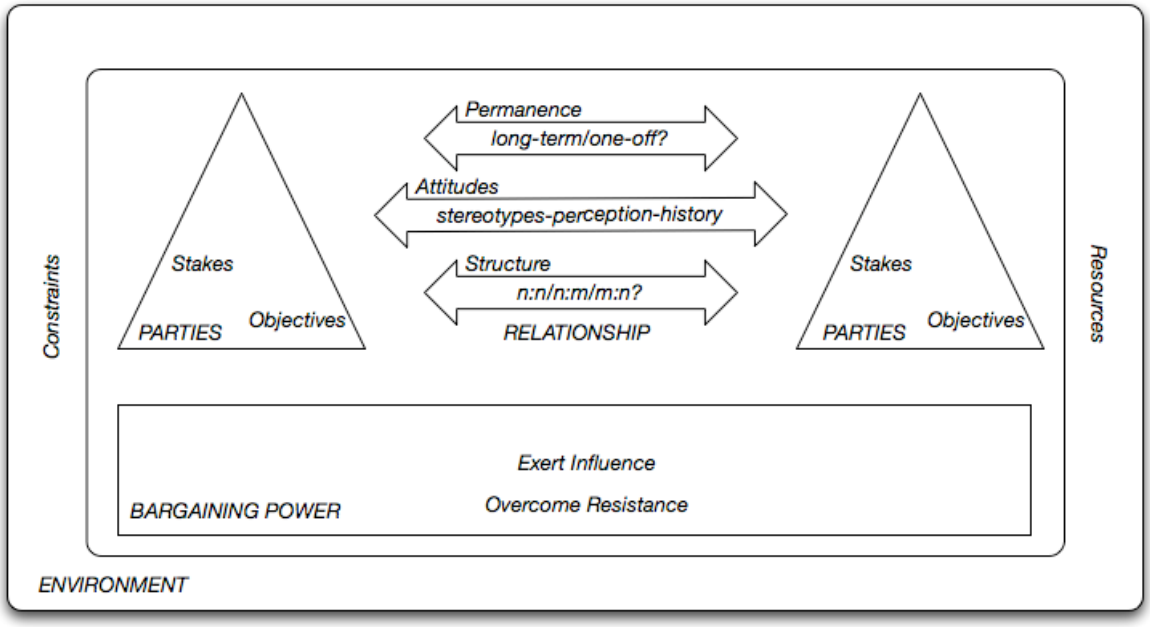

Figure 9-1: Rojot's Framework of Negotiation

Starting with the parties and the relationship between them, the attributes that define a negotiation are the degree of permanence of the relationship between parties e.g., long term vs. one off encounter, attitudes towards each other e.g., stereotypes, and whether or not it is a negotiation between individuals or between groups. Environmental attributes define the context of the negotiation: the parties, their stakes and their objectives, and also represents resources and constraints. Some attributes are fixed, while others are changeable. Some are static, while some change over time. Finally, bargaining power refers to the capability of a party to exert influence or overcome resistance. Bargaining power is essential to negotiation because:

> *If one party has no power over the other, we are no longer in the framework of a bargaining relationship, but in a situation entirely different, in another type of case where, for example, only hierarchical power counts.* [208]

It is easy to draw parallels between this framework and our earlier statement of everyday behavioural change being a matter of compromise. In Section 9.1 we identified the main elements of such compromise to be clinical guidelines, perceptions of health and health-related behaviours, competing values, resources, and self-determination. Over the course of the following three sections we will explore the compromise of everyday behavioural change within the presented framework of negotiation, then extend our discussion to consider the implications for sociotechnical everyday health promotion interventions.

Far from being a comprehensive overview of all possible scenarios, the examples that follow simply serve to illustrate the framework concepts. When considering what these concepts mean for negotiation as a framework for everyday health promotion interventions, we must identify which aspects can be accounted for in system design. Where relevant, we will reference the recommendations that were made previously in Section 9.2 in order to locate them within the context of this framework. At the end of each section we will use the components that have just been described to characterise a scenario for negotiation.

9.3.2.1 The Parties and their Relationship

The most obvious parties for consideration are the individual and the establishment. The establishment refers to those who formulate and advocate the national guidelines for health and health-related behaviours: ranging from an individual health professional to a government body. The establishment's stake in negotiating health-related behaviour relates to the health of a population, which leads to a decreased burden on the health service and a more productive workforce. Their objectives are to promote adherence to the guidelines that they advocate.

As has been seen throughout this thesis, an individual's stake includes the time and money necessary to engage in behavioural change and participate in a particular behaviour, and their competing values and interests. The individual's objectives appear to be heavily dependent on the context in which change is being considered, Broadly speaking, within Weight Management the objective was to lose weight, within the Families at Risk it was to do as well for the family as circumstances allowed, and within Cardiac Rehabilitation it was to get back to normal.

In addition, we would suggest that third parties to be considered are the members of an individual's social network, who have been shown in this thesis to be inherently involved in health-related behaviour and behavioural change (either actively or passively). We cannot infer the typical stakes and objectives of third parties from the studies that were carried out for this thesis. In order to establish this more research is required.

As Rojot's framework indicates, a negotiating party need not necessarily be an individual. It is here where a shift from the traditional focus can be envisaged. Very much in line with the community-based models of health and health promotion that were discussed earlier in this thesis (Chapter 2.3), a community can be considered to be a negotiating party. As with the stakes and objectives of social networks, we are not in a position to infer those of a community. However, from the collective concern of the Families at Risk participants we know that access to affordable healthy food as a potential objective. Other objectives may include improving quality of housing and security in the community.

Rojot characterises the relationship between negotiating parties according to its degree of permanence, quantitative structure, and the attitudes that each party hold towards each other. Of these characteristics, attitudes was the most evident in this thesis: the authority afforded to the health care professionals (CR), the low impact of health messages that were not culturally relevant (FAR), and the measurement of relative comparability between peers as a determinant of information disclosure (WM). The impact of permanence and structure on the negotiation process is easy to appreciate. A one-off negotiation with a stranger will take a very different form than an ongoing negotiation with a long-term companion. Table 9-2 presents an overview of Parties' characteristics and associated design strategies that will be discussed next.

Attributes	**Possible Values**	**Design Strategy**
Identity	Individual, Peer, Family, Community, Establishment	Embody or Mediate
Stakes	Time, Money, Health, Interests, Values	Explicit Inclusion or Support Articulation
Objectives	Behavioural, Physiological, Emotional, Psychological	

Table 9-2: Parties' Attributes and Design Strategies

Technologically, the *parties* are an interesting place to start first and foremost because it raises the issue of whether technology is intended to mediate between parties, or embody one party. Examples of embodiments would be technologies that act as a proxy for health professionals, such as the ECAs discussed in the previous section (9.3.1), or systems that seek to emulate a particular form of peer-involvement (C1.a). In contrast, in online

communities or technologically facilitated patient-clinician consultations, the technology performs a mediatory function. If developing for embodiment, the *objectives* of the represented party must obviously be included in the system design. However, designers may choose not to explicitly include the objectives of non-represented parties, instead leaving the declaration of objectives to the parties themselves. This is likely to be necessary in systems that allow for non-behaviourally focussed objectives; while it is relatively easy to incorporate quantitive objectives such as minutes of exercise per day in system designs, more subjective objectives such as emotion and 'enough' are less readily represented (M3.c). Perhaps because of the dominant focus that behavioural change holds, it seems natural that objectives be accounted for in system designs, In contrast, representing a party's *stakes* appears to be more of a departure from traditional approaches, but may well fit with the more holistic approach that we advocate here. The same questions regarding explicit inclusion or support for expression that apply to objectives also apply here. Table 9-3 presents an overview of Relationship's characteristics and associated design strategies that will be discussed next.

Attributes	**Values**	**Design Strategy**
Structure	One-to-One, One-to-Many, Many-to-Many	Binary Choice
Stakes	One-Off, Short-Term, Long-Term	
Attitudes	Stereotypes, History, Culture, Perceptions, Hierarchy	Support, Challenge, or Remain Sensitive Implications for Interaction

Table 9-3: Relationship's Attributes and Design Strategies

Moving from the parties to the *relationship* between them, the framework offers three aspects for consideration. We would argue that decisions regarding *structure* and *permanence* are inherent in any design, in the questions of whether to support individual or collaborative negotiation and whether or not the system is intended for one-off, short-term, or long-term use, or between strangers or existing peers. The issue of *attitudes* is one which designers should remain sensitive to, be it through designing for cultural relevance (M2.a), supporting or challenging stereotypes (C1.b), or being aware of the implications of hierarchy within a system (actual or perceived) and an awareness of any subsequent consequences for interaction (M2.b, M2.c). Perhaps the most relevant recommendations to be made with respect to the relationship between parties can be found in Section 9.2.3, whereby the scope and mechanics of peer-involvement within each of the study domains is given explicit consideration.

We can use the components of Parties and their Relationship to characterise a scenario for negotiation. Table 9-4 presents an illustrative example that was informed by the findings of the Weight Management study.

Party 1	
Identity	Individual (Wife, Mother)
Stakes	Time, Health, Weight, Body Shape, Self-Esteem, Domestic Role
Objectives	Wear Size X Clothes
Party 2	
Identity	Family (Husband, Daughter)
Stakes	Time, Health, Lifestyle, Domestic Routine, Hobbies
Objectives	Maintain Status Quo
Relationship	
Structure	One-to-Many
Permanence	Long-Term
Attitudes	-Party 1 doesn't think it is Party 2's problem -Party 2 doesn't think Party 1 needs to change -Party 1 is reluctant to ask Part 2 for help with domestic chores

Table 9-4: Example Party/Relationship Analysis of WM Scenario

The design suggestion that was offered in Chapter 6.7.3 was that of an ambient interface in the home that highlighted the temporal demands of the family's domestic routine. With respect to the design strategies suggested in this section, such an approach can be characterised as mediatory, supporting expression of stakes and objectives between a family (one-to-many, long-term), and to be used over the long-term. The interaction that the system affords (indirect, selective and incremental) reflects the existing attitudes and aims to support existing practices.

9.3.2.2 The Environment

The environment of everyday health-related behavioural change is an individual's everyday life. The five levels of dietary determinants offered by Dixon and Paxton [280](see Chapter 2.2.2) provide a useful guide to thinking about the many levels of resources and constraints to be found in an individual's everyday life. The five levels are: personal, home and family, local community, mass media, and wider community. Taking examples from the studies in this thesis, here we offer resources and constraints at each level that we suggest can help or hinder willingness or ability to engage in health-related behavioural change. It should be noted that the examples are somewhat skewed towards the perspective of the individual as the negotiating party; this is a result of the focus and orientation of this thesis.

- Personal: in addition to the values and interests that predispose an individual to want to participate in a particular behaviour (categorised as a party's stake within this framework), personal resources and constraints for negotiation include an individual's (in)ability and (un)willingness to seek support and articulate arguments, and having the knowledge, skill and physical capability to participate in an activity or implement change.

- Home and Family: while those who have a social network are more advantaged than those who are socially isolated, having children who refuse to eat new food or having a partner who smokes are examples of how family members can also be a constraint. Domestic routines can also promote or hinder attempts to make behavioural changes, as can the physical space, or lack of, in the home. Furthermore, as much as the individual has personal resources and constraints for negotiation, so does each friend and family member.

- Local Community: if the social norms surrounding particular health-related behaviours foster discussion, reflection or participation, then social norms are a resource for positive health behaviours. If not, the social norms of a local community are constraining. Alternative resources and constraints include the degree of availability and opportunity for participation in particular behaviours, be it in the form of local shops selling affordable food, safe local parks, and local health and community service provision—or lack of.

- Mass media: although not explicitly explored within this thesis, imagery relating to body shape can be viewed as both a resource and constraint depending on the viewpoint being taken (as mentioned briefly in Chapter 6). Additionally, the portrayal of 'the gym' also simultaneously provides a resource for motivation for some while demotivating and constraining others.

- Wider Community: in addition to the role that legislation plays in the creation and maintenance of many of the resources and constraints found in a local community, other aspects of legislation are the availability of funding to implement change, the determination of positive health-related behaviours, and prioritisation of behaviour-specific interventions.

In addition, we propose that technology is a resource and constraint that pervades each layer of this sociotechnical framework. We encourage designers to consider the technology that is currently available to the involved parties and the cost (financial, temporal, cognitive) of introducing new technology or making new demands of existing technology (bandwidth, data rates). However, we would suggest that populations should not be discounted from consideration as potential users of technological interventions on the basis that they are not obvious consumers or do not have cutting-edge technology; this leads to the acknowledgement that interventions may have to be designed that utilise less-than-cutting-edge capabilities. We also recommend that the party's overall attitude towards technology be considered as a potential resource or constraint for consideration, albeit at a personal level. For example, the unwillingness to use technology 'for technology's sake' that was observed during the Cardiac Rehabilitation study would be considered a constraint on the potential scope of technological interventions.

In contrast to the technological implications of parties and their relationships, whereby the primary design decision is whether to account for particular attributes or simply remain sensitive to them, here we find it to be matter of acknowledgement, exploitation, or development. It is within this component of Rojot's framework where we can place many of the design suggestions that have been offered throughout this thesis. Reflecting the focus of this thesis, the remainder of this section focuses on resources and constraints from the personal, home and family, and local community levels. Table 9-5 presents an overview of Environment's characteristics and associated design strategies that will be discussed next.

Attributes	**Values**	**Design Strategy**
Resources	Personal, Home and Family, Community Level, Mass Media, Legislation	Exploit, Highlight, or Develop
Constraints		Acknowledge

Table 9-5: Environment's Attributes and Design Strategies

At the most basic level, we have suggested that designers should acknowledge that *constraints* exist. Such an acknowledgement can be reflected within system design, in the aim and scope of technological interventions, and in the development of non-technical interventions. For example, we have argued that designs should allow for partial change (I2.a), even if it means that the successful outcome of a behavioural change intervention does not meet the standard of national guidelines. In the Lifestyle Coaching Application [103] that was introduced in Chapter 3.3, users were challenged to eat a set number of fruit and vegetable portions per day. If the individual is unable to consume that amount fruit and

veg due to financial constraints (personal constraint), rather than being unwilling to, then the challenge being set is inappropriate.

In the case just discussed the acknowledgement of constraints leads to a specific design recommendation, but in most cases it causes us to reconsider the nature of the problem and the appropriateness of technological approaches. For example, we have argued that people who stand to benefit most from social support interventions may be the least likely to use them. Acknowledging that such a constraint exists (personal level: social skill) prompts us consider the need for 'offline' efforts to promote social and support-seeking skills (C3.b). Similarly, the limited financial resources (personal constraint) of the Families at Risk participants and reluctance of children to eat new food (home and family constraint) led to the suggestion that developing technology to raise a caregiver's motivation to change may not be appropriate unless matched with efforts to reduce existing barriers (M3.d).

Therefore, technology could be designed in such a way that it contributes to the development of available *resources*. While there is little that technology can do to decrease the economic constraints of individuals, we proposed that budgeting and planning applications could be developed to assist individuals make the most of the financial resources they have (I1.b), while potentially contributing to skill development (personal resource: budgeting skills). Social capital is another resource to which we have suggested technology is in a position to contribute (I1.c). Consider the case of an individual who does not like the idea of exercising in a gym (personal constraint: preference), does not equate daily activity as exercise (personal constraint: perception), and does not know of any alternative that he or she would enjoy (personal constrain: experience). As has been suggested numerous times in this thesis, if the individual does not know anybody who participates in any alternative forms of exercise then it is unlikely that he or she will be exposed to any alternatives (home and family constraint: peer's interests, mass media constraint: imagery surrounding exercise and marketing of gyms). We have suggested that technology be used to expose individuals to alternative perspectives, in this case that doing exercise is not limited to sporty (thin) types working out in the gym. In a similar manner to the WM example for technological support of passive peer-involvement (see Chapter 6.7.3), an application could highlight and compare the exercise strategies, progress, and experiences of others who are comparable to the individual. In this case, the system could actively seek out comparable individuals who participate in non gym-based activities and

highlight those who participate in activities that are possible in the individuals surrounding environment (local community resource: facilities).

Finally, and in line with the community-based resilience-focussed approach advocated by Davis et al [76] (see Chapter 2.3.3), it is not necessary to focus solely on the negatives, and technology could be designed to exploit the resources that are available: be it through applications that highlight their availability (I1.c, I1.d.ii) or tailoring interventions to specific environmental contexts (as suggested above). The EatWell system [116] is illustrative of a resilience-focussed approach that also contributes to the development of a particular resource. During the user study low-income community members used the system to highlight good places to buy healthy food (highlighting resources), while their experience sharing resulted in enhanced social capital (developing resources).

Again, we can use the components to characterise a scenario for negotiation. Here we use Parties and Environment, focussing specifically on the Home and Family layer. Table 9-6 presents an illustrative example that was informed by the findings of the Cardiac Rehabilitation study.

Party 1	
Identity	Individual (Husband, Manual Worker)
Stakes	Time, Money, Health, Cardiac Condition, Self-Esteem, Working Role
Objectives	Get back to normal, stop smoking, improve diet
Home and Family Environment	
Resource	He cooks, Wife has access to cardiac education literature
Constraint	Wife (smokes, buys microwave meals)

Table 9-6: Example Party/Environment Analysis of CR Scenario

In Chapter 8.9, we suggested that technology is ill equipped to contribute to this scenario. If we refer to the design strategies offered by this framework, the options are to exploit, highlight, or develop resources or acknowledge the constraints. Even though one of his objectives was to improve his diet, and he benefitted from having the domestic role of cook, he depended on his wife's role as shopper to buy the food that he would subsequently cook. It is difficult to see how technology could realistically contribute, it is tempting to suggest that an intervention be developed to further educate Party 1's wife (develop resources), but the lack of support appeared to come from a lack of interest rather than from a lack of knowledge (see Chapter 8). In this case acknowledging the resources and constraints of Party 1's home and family environment, we acknowledge that such technological interventions are inappropriate.

9.3.2.3 Bargaining Power

The notion of bargaining power, as intrinsic to negotiation, is also intrinsic to the motivation behind the suggestion of designing for negotiation. At the beginning of Section 9.3 we identified clinical approaches to promoting health-related behavioural change as having a hierarchic nature. We then went on to suggest that the same hierarchic approach is being mirrored in existing technological approaches. Indeed, the overall aim of persuasive computing is to *exert influence* over the attitudes and behaviours of users; the persuasive strategies that are employed are designed to *overcome resistance*. At present the onus is on the user to respond to the demands of the technology. Although the ultimate power still lies with the users in that they can simply reject the technology, when arguing for negotiation as a framework for technological interventions, we seek to rebalance the power structure and explore how technology can be designed to respond to the user's counter-demands. Subsequently, when designing for negotiation the individuals become active agents in the negotiation process rather than passive recipients of behavioural instruction. This is evident in our recommendations to design for action (M3.d), address barriers to change (I1.a-d), and allow partial and incremental change (I2.a-b). Table 9-7 presents an overview of Bargaining Power's characteristics and associated design strategies that will be discussed next.

Attributes	Values	Design Strategies
Exert Influence	Behaviours, Goals, Outcomes, Implementation Strategy, Resources, Commitment	Support or Facilitate
Overcome Resistance		

Table 9-7: Bargaining Power's Attributes and Design Strategies

It may well be that the outcomes of everyday health promotion technology interventions conflict with the goals of traditional approaches to promoting health-related behavioural change. Although this could seem to be counterproductive, it resonates with community-level models of health and behavioural change that emphasise the importance of approaching problems from the perspective of community members rather than the establishment (see Chapter 2). On a pragmatic level, it may be a necessary sacrifice if systems are to be adopted. When designing for populations other than early adopters, there has to be an obvious value to introducing technology if it is to be accepted [177]. This sentiment was expressed most explicitly during the Cardiac Rehabilitation study (Chapter 8) and alongside the financial constraints of the Families at Risk participants (Chapter 7) illustrates that multifaceted nature of the cost benefit trade-off of introducing new

technology. The challenge of technology acceptance further supports the argument of approaching the problem space from the perspective of the individuals.

The two design strategies identified in Table 9-7 are supporting and facilitating a party's bargaining power. Supporting bargaining power at the most basic level would involve the self-determination of goals (I2.a-b), as was discussed in the previous section. When considering how technology could be designed to facilitate one party's efforts to exert influence over or overcome resistance by another, we turn to the Families at Risk study for an example scenario (see Table 9-8).

Party 1	
Identity	Local Community (Low-income Families)
Stakes	Time, Money, Family Health, Quality of Life
Objectives	Improve access to affordable healthy food
Party 2	
Identity	Wider Community (Government)
Stakes	Time, Money, Health of the Population, Burden on Health Service, Productive Workforce
Objectives	Improve adherence to nutritional guidelines
Bargaining Power (Party 1)	
Exert Influence	Campaign
Overcome Resistance	Vote

Table 9-8: Example of Bargaining Power Analysis of FAR Scenario

Unlike the examples presented in the previous two sections, the examples that we are going to discuss here have not yet been presented in the corresponding study chapter. The role of the government has not been the central focus of the work in this thesis and so has only been discussed briefly. By including it in this discussion we start to explore the potential scope for negotiation within this domain. As can be seen from Table 9-8, we have identified two ways in which a local community has bargaining power over the wider community. They can exert influence though participation in campaigns and, presuming a suitable alternative is available, they can overcome resistance by voting for an alternative political party.

Apart from digital voting [155], technology can also facilitate informed voting. For example, an application could gather the policies of each party that are most relevant to the local community as identified by the community members themselves. In this case the relevant policies could include the sourcing and pricing of fresh food, provision of local amenities, and restrictions on the number of fast food outlets. The interface could then convey the details of the policy in a manner appropriate to the community itself, and

highlight the positive and negative consequences of such policies. In a similar manner to our earlier recommendation to develop technology in order to ensure an individual's health-related behavioural choices are as informed as possible, here we have suggested that technology could do the same for political choices.

Designing for campaigns is something that is already being investigated by members of the research community. Goecks at al [110] recently performed an analysis of technology use in nonprofit organisations. One of the web-based organisations that they studied is illustrates how such resources can be used to campaign for change:

> *Change.org is a website that enables users to organize, communicate, and take action based on shared goals called "Changes." Example Changes include 'Stop Global Warming' and 'Improve Public Schools.' Any user can create a Change and join a Change's group. Associated with each Change group are numerous types of user-generated content such as the names of preferred politicians, links to related resources, and group impact measures such as the number of group members, actions taken on behalf of the Change, and total donations contributed by the group.*

Although specifically concerned with technology use in nonprofit fundraising, some of the insights gained into the role that technology plays may well be applicable to more general campaign technology. Substituting the terms 'donor' and 'nonprofits' for 'campaigner' and 'the campaign', three of the roles that seem particularly relevant are:

- communicating information about the campaign
- helping potential campaigners discover the campaign
- enabling individual and community advocacy

In contrast, the Participate Project[42] investigates designing for mass participation in campaigns and events. So far, the focus has been on designing for campaigns directed at the public rather than the government, an example application of theirs being a pervasive game that "invites players to reflect on their environment and the impact they have on it" [58]. One of the project's ongoing research aims is to identify what design components are necessary to encourage and sustain motivation in public campaigns; sustaining collective action was also identified by Goecks at al [110] as an outstanding research challenge, and

[42] http://www.participateonline.co.uk/

we suggest that it is of great relevance to the concept of bargaining power and negotiation in general. It will be interesting to see how transferable recommendations are; to establish how significant the focus, direction, and nature of campaigning is on the design requirements for any subsequent everyday health promotion intervention.

9.3.3 Everyday Health Promotion Interventions

Rather than attempting to develop an application that encapsulates the whole process of negotiation, we consider that a more likely and appropriate strategy for everyday health promotion interventions in this area is to focus on one aspect of negotiation. We hope that the examples given in Section 9.3.2 have served to illustrate this point. We suggest that technologists consider the overall process of negotiation as being an ongoing one that occurs within the broader context of an individual's everyday life—through their everyday interaction with their personal, social and surrounding environment. The aim of everyday health promotion interventions then, is to contribute to one particular aspect of the broader ongoing process of negotiation.

Because of the multifaceted nature of the problems of physical inactivity and poor dietary intake, there will be no silver bullet. Rather, interventions (technical and non-technical) are more realistically viewed as small hammers that can be used to chip away at a large problem. We suggest that the framework be used to identify ways in which technology can (and cannot) be designed to operate within an individual's everyday life and identify where non-technical interventions may be required to run in parallel with, or instead of, technical interventions.

9.3.4 Alternative Perspectives

It could be argued that by respecting the right of the individual to make 'bad' behavioural choices that we are seeking to support the needs of the individual rather than society as a whole. A more authoritative approach, by enforcing change, would reduce the burden of healthcare costs. In a similar manner to the decision to withhold surgery from smokers [191], technology could be developed to monitor adherence to behavioural guidelines and access to health services could then be allocated accordingly. Such a strategy appears to support to the notion of a nanny state, and does not acknowledge the social inequalities that are proven to contribute to participation in health-related behaviours.

The role of mass media and governmental influence on health-related behaviours has been touched upon at various points in this thesis but not discussed in depth. A thorough exploration of these topics is outside the scope of this thesis, but it is useful to consider them here so that we may outline the limitations of the approach that we have proposed.

In the same way that there is a limitation to what can be achieved at the individual-level, there is also a limitation to what can be achieved at the interpersonal and community-levels. While peers construct social norms that influence perceptions of what is enjoyable, desirable, important and effective, the media are also extremely influential [40]. There is much literature linking the mass media with body image and eating disorders, one particularly startling example being study of the impact that the introduction of television in 1995 had on Fijian females:

> *It broadcast programmes from the United States, Great Britain, and Australia. Until that time, Fiji had no reported cases of eating disorders, and a study conducted by the Anthropologist Anne Becker showed that most Fijian girls and women, no matter how large, were comfortable with their bodies. In 1998, just three years after the station began broadcasting, 11 percent of girls reported vomiting to control weight, and 62 percent of the girls surveyed reported dieting during the previous months. [40]*

However, there are also examples of how media can contribute to a shift in public perception of health-related behaviours:

> *Media messages reinforce dominant values and support existing social arrangements, that is, social control. The social norm regarding smoking is a reflection of this principle in practice. Smoking has evolved from a widely accepted and even highly encouraged phenomenon to the norm that it is unacceptable to smoke given its deleterious consequences for smokers and those exposed to secondhand smoke. [184]*

The drive to change public perception and practice of tobacco use did not originate in the media; efforts were initiated by government policies, sponsorship or regulations [202]. Since 1965, the rate of tobacco usage has halved in the United States to 21% [184]. The most recent examples of governmental policy contributing to smoking cessation are the smoking bans that have been applied in various countries, effectively outlawing smoking in work- or public places. These bans seem to have had positive effects on the reduction of tobacco use [187] and the occurrence of secondary conditions [86, 144, 202].

The governmental regulation of health-related behaviours that are the focus of this thesis would be more challenging from both a practical and ethical perspective. There are fundamental differences between tobacco use, dietary intake and physical activity. The most obvious being that it is necessary to eat to live, and the problem of physical activity is one of behavioural induction rather than cessation. Furthermore, the impact of industrialisation and environmental influences on physical activity and dietary intake that were discussed in Chapter 2, has led to references being made to an "obesogenic society" [189]. Ethically, we should be cautious of making people take responsibility for things that they might not necessarily have control over.

9.4 Conclusion

This chapter has drawn together the findings of the previous three chapters, and considered them alongside related work in the technological and sociomedical domains. Reflecting the multidisciplinary nature of this work, the discussion that ensued was structured around the three levels at which this work makes a contribution. Starting from the perspective of the populations involved in this thesis, the chapter presented an overview of the insight that was gained into the practice and experience of everyday behavioural change. The chapter then proceeded to further discuss the implications of such insight for research and design. Finally, the chapter challenged what appear to be implicit assumptions about technology's role in promoting health-related behavioural change. It prompted a consideration of whose agenda in being pursued, whose values are being encapsulated, and argued for a rethink and reorientation of technological interventions in this domain, suggesting a shift in focus from behavioural change to health promotion; from persuasion to negotiation.

10 Conclusion

> *In essence, pervasive healthcare addresses a set of related technologies and concepts that help integrate healthcare more seamlessly into everyday life, regardless of space and time.* [21]

When considering the domain of everyday behavioural change technology, much attention has been paid to the adequate representation of clinical aims and techniques. In contrast, there has been relatively little investigation into what is required to integrate the aims and techniques seamlessly into everyday life, let alone investigations into whether these aims and techniques are needed. The work in this thesis provides insight into the everyday component of everyday health technology; thus complementing recent technological advances in the automatic sensing of health-related behaviours and engaging persuasive experiences.

10.1 Thesis Summary

In order to suitably locate this work within its broader sociomedical context and provide a point of reference to the theoretical grounding of many of the systems to be discussed in subsequent chapters, Chapter 2 introduced the problems of physical inactivity and poor dietary intake. It provided an overview of the sociomedical background of health-related behaviour and health-related behavioural change. Furthermore, limitations of traditional

approaches to promoting health-related behavioural change were discussed and the question of whether or not we should be striving to emulate such approaches was first raised.

Chapter 3 then provided an overview of everyday behavioural change as an application domain within HCI. In view of the non-clinical nature of most emerging applications, it argued that they are in effect everyday health applications which individuals are free to engage with at their leisure. Historically limited to clinical domains, everyday health applications promise to liberate behavioural change techniques and programmes in the same way that the Internet increases access to information. However, it argued that they tend to encapsulate many of the aims and techniques of the traditional approach to promoting health-related behavioural change: focusing on the responsibility of the individual to change and one particular 'problem' behaviour in isolation.

Chapter 4 presented our initial explorations of the area in accord with the aforementioned approach. People enjoyed using Shakra and appropriated it for use in ways that suited the nature of their group and their own motivational preferences. Shakra became a resource for interaction around which physical activity became a topic of conversation between study participants and peers not involved in the study. In addition to self-monitoring raising awareness of actual physical activity levels, the application itself raised awareness of the issue of physical activity, suggesting that the socialisation of self-monitoring is a promising avenue for persuasive technology. The chapter ended with a reflection on the approach the merits and limitations the approach that had been taken, and argued for a need to investigate peer involvement in behavioural change within a variety of contexts other than the well and well-motivated populations represented in the majority of the work done within HCI.

Chapter 5 then presented and justified the methodological choices that informed the subsequent studies that formed the core of this thesis. It argued for an ethnographic approach, and because of the spatially and temporally disparate nature of the topic of investigation, made an argument for ethnographic interviews in particular. The analytic orientation of the author was made explicit and the interpretive framework that was used to make sense of the data, and subsequently structure the following chapters, was introduced.

Chapters 6 to 8 presented the findings of our three studies of everyday behavioural change in Weight Management, Families at Risk, and Cardiac Rehabilitation. In addition to the

insights gained with respect to the nature and mechanics of peer involvement, the studies highlighted subtleties of everyday behavioural change that could easily be overlooked if one assumes that the traditional structure and values of clinical behavioural change programmes apply. These subtleties related to the underlying and competing motivations and the availability and determination of strategies to implement change. At the end of each chapter consideration was given to the implications of such findings for existing and future technological innovations.

Chapter 9 drew together the empirical and analytic material provided in the previous three chapters to develop further analysis and reflection. Analysis was performed and presented at three levels: the nature of everyday health-related behavioural change, the implications for research and design, and the nature of technology's role. This chapter formalised the argument that was being constructed in each of the previous chapters, that promoting positive health-related behaviours should be a matter of negotiation rather than persuasion. In order to provide a starting point for the further exploration of negotiation as a paradigm for health promoting technology, Rojot's [208] framework of negotiation was introduced and discussed.

10.2 Contributions

This thesis set out to investigate of the practice and social dynamics of everyday health-related behavioural change, and to explore and map out a design space of appropriate technological interventions. In particular, it aimed to include and engage populations who have so far been underrepresented.

The main outcome of this research is the insight gained into everyday behavioural change as experienced by groups of people affiliated by their socioeconomic status (families at risk), medical history (cardiac rehabilitation) or self-perception (weight management). The findings of each of these studies provide an empirical contribution to providing a better understanding of the problem domain from the perspective of those populations. Each of the study chapters provides a useful point of reference for technologists who are unfamiliar with the respective domain but seeking to develop technologies for it. Analytically, the interpretive framework that was used also highlights particular aspects of health-related behavioural change that technologists may use to guide the focus of their efforts. The abstractions and conceptualisations that were derived from the data also serve to sensitise technologists to what has proved to be a complex problem space.

The findings of each study informed a critique of current approaches and the identification of areas of opportunity and constraint for technological interventions. Therefore, an additional contribution of this work is the generation of actionable implications for research and design. Domain specific implications were drawn out of each study's discussion, and were presented in concise form in the conclusion of each chapter. An extended discussion in Chapter 9 also synthesised the domain-specific implications, to point to areas of commonality and distinction, and suggest areas of broader applicability. While the domain specific guidelines will be of interest to technologists working within those specific domains, the discussion in Chapter 9 will prove useful for those concerned with more general applications for health-related behavioural change, and for those working in domains not addressed in this thesis.

As was mentioned at the beginning of Chapter 9, the implications for design that have been presented in this thesis are the result of our analytic orientation. Others may choose not to refer to the implications in this thesis, but may choose to revisit the findings presented in the chapters and derive implications that are more consistent with their aims and objectives. For example, while we have not interpreted any of the practices of participants as 'wrong', others may look to the findings of our studies to inform design efforts to correct practice that deviates from what they believe to be desirable behavioural change.

Overall, the main contribution of this thesis is a reframing of the problem of promoting health-related behaviour as more than a simple matter of behavioural awareness and personal motivation. This argument was informed by a consideration of the findings of each study alongside the bodies of sociomedical and technological literature that were presented in Chapters 2 and 3. By acknowledging the strengths and limitations of persuasive technology, and offering negotiation as a potential model for future innovations, this thesis contributes to the further development of theory that informs future research in the area of everyday health applications and Pervasive Health.

10.3 Limitations and Future Work

As with any research that relies on the voluntary participation of human subjects, our findings are skewed with respect to the self-selective nature of study participants. We are not in a position to speculate whether the mindset and experience of the people who were willing to participate are representative or significantly different than those who decided not to participate. We suggest that this does not affect the validity of the results presented

in this thesis, as we do not make claims of generalisability beyond this group. Nevertheless it is a limitation that future work should seek to address.

For example, in the Families at Risk study we recruited via a community outreach project. Although the services provided by the community outreach project were available to anyone in the community (and free of charge), not all families chose to use the service. If it is only the more motivated and engaged parents who actively seek such service, we cannot rule out the possible disproportionate representation of motivated caregivers in that study. To overcome the limitation of such a recruitment strategy, future recruitment efforts would need to be focused on those who do not use the service. Similarly, by the very nature of the Cardiac Rehabilitation study, we automatically excluded people who chose not to attend rehabilitation, or were not able to for reasons outside of their control. With hindsight these may well be the very people who stand to benefit most from any technological innovation in the area, and as with the Families at Risk study, future studies should strive to recruit non-attendees.

However, knowing who we should focus efforts on does not solve the challenge of how to recruit them. This is also applicable to the Weight Management study, if not more so, because the non-participants are less readily identifiable: the people who saw the recruitment material but chose not to participate. There will always be people who do not want to participate in a study, but efforts should be made to be as inclusive as possible. The studies in this thesis represent a step towards engaging populations not traditionally involved in HCI, but it is a *first* step.

The limitations of all semi-structured interview-based studies also apply here, that the findings are based on what people say they do rather than what they actually do, and that we cannot rule out the chance that participants told us what they thought we wanted to hear. As with the additional limitation of only gaining partial insight (that applies to all studies), there is little that we can do other than acknowledge that these limitations may exist. Any implications that have been drawn from 'false' findings are likely to become evident over time, either through the rejection of designs that embody such implications or as the body of knowledge and understanding of the domain grows.

We are also aware that the implications for research and design that have been presented have not yet been implemented, and so as yet remain suggestions that are grounded in the data and analysis of this thesis, rather than validated guidelines. We are aware that many

of the design and implementation details are left unaddressed. It is through more focused sessions that we, or others, might address the design challenges raised by the suggestions made in this thesis. Indeed, throughout the duration of this research the author has been left uneasy by the feeling that the work in this thesis raises more questions than it provides answers. It is from such questions that future work can be identified; here we focus on three ways in which this thesis might be extended into future research activities.

An obvious starting point for taking this work forward is through the *implementation and validation of the design suggestions* that have been put forward by this thesis. In one case, that process has already begun. Since the Families at Risk study took place, the collaborators have continued working with the community outreach project. They have carried out several participatory design workshops, which the author had designed, with groups of caregivers and children. Preliminary results have been submitted for publication. Furthermore, the author's primary collaborator, Katie Siek, is in the process of writing a funding proposal to continue working on the seasonal hybrid game concept that was presented in Chapter 7, and an industrial organisation has expressed an interest in being a partner on the project. In addition to the design challenges of creating an appropriate and engaging game that is fun and safe to play, a great emphasis will be placed on utilising affordable technology that will be accessible to the population for whom it is designed. Once the concept has been developed and a game has been designed and implemented, long-term large-scale user studies will be required to establish behavioural outcomes. Other potential projects include the confidence by proxy application for immediate family of cardiac rehabilitation participants, and the augmented monitoring application to convey the physiological and value-based benefits of physical activity.

It should be noted that behavioural outcomes might not necessarily be the appropriate outcome measures for work that is informed by this thesis. The emphasis on much of the work is providing opportunity and choice, and as standalone applications may have little behavioural effect. Particularly when considering technological interventions to foster social capital, a more appropriate measure of success may be long-term use and social cohesion. *Exploring the scope for technologically facilitated social capital* is another avenue of future work. While the previous suggestion focussed on particular interventions, this programme would investigate the broader challenges of fostering social capital with technology. Issues to be explored would include the difference between fostering social capital within a population defined by geographic location, medical condition, or gender,

the feasibility of technological strategies to overcome existing social barriers, designing for inclusion, and integration and collaboration with community resources (to name just a few). Chapter 2 presented Carpiano's [57] framework of health-related social capital that could be used as a starting point for investigations alongside the various suggestions have been offered throughout this thesis with respect to possible design instantiations, and the existing literature surrounding online social capital for education and the workplace [2, 219, 224]. The notion of fostering health-related social capital with technology is an attractive one, but as yet is relatively undefined.

Finally, it is hoped that future work will *further develop the paradigm of negotiation* within pervasive health. At the moment, the concept is somewhat embryonic. The framework offered in the previous chapter serves well to sensitise the reader (and the author) to the possible design space for health-related negotiation, but a more thorough understanding of negotiation is required. The overall argument for negotiation was constructed over a series of studies and informed by both the technological and sociomedical literature. It is likely that to take the concept forward we will have to return from the general to the specific, identifying the key attributes that are required for negotiating health within specific populations, and exploring ways in which technology can be designed to satisfy those needs. As our understanding and experience in negotiation grows, we can move again from the specific to the general and develop a sociotechnical framework for health-related negotiation.

11 Appendices

11.1 Shakra Implementation Details

A client-server architecture was used in Shakra (see Figure 11-1 overleaf). The client was built for Windows smartphones running Windows Mobile 5 (WM5). In the system trial the particular phones used were i-mate sp5s, which had SIM cards enabling them to connect to a commercial mobile phone network for data transfer. The client was implemented in C# using the .NET compact framework. A web service was used so that clients could upload their own and download others' data. The web service ran on a server running Windows Server 2003 and the data uploaded was stored in a MySQL database.

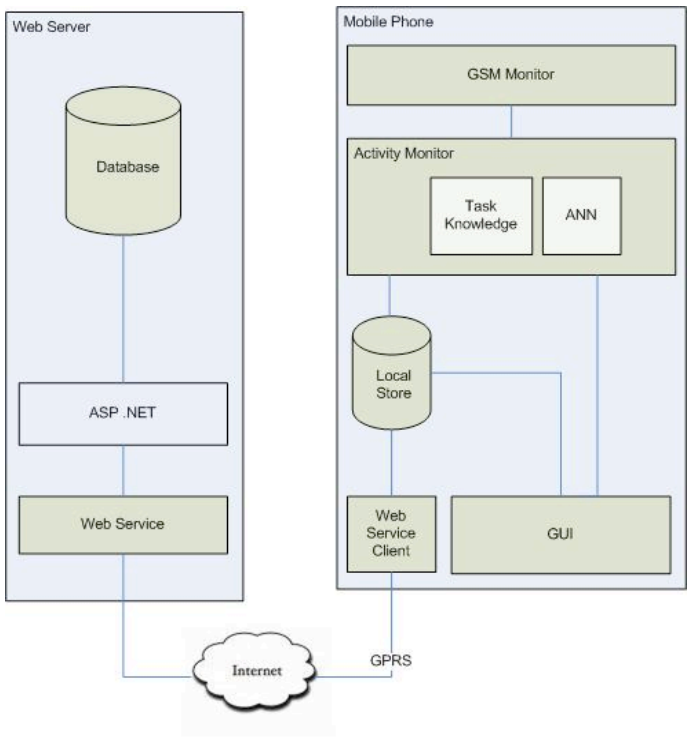

Figure 11-1: Shakra System Architecture

11.1.1 Sensing Physical Activity

The current activity of the user is inferred using patterns of fluctuation in GSM signal strength and changes to the ids of detected cells. This method, the GSM Context Awareness System (GCAS), has been demonstrated as a reliable and unobtrusive way of sensing current activity [11], and at the time had the advantage over the more traditional approach of using an accelerometer in that it does not require additional sensor hardware as was discussed in Chapter 3.2.

Rather like a traditional accelerometer, when a mobile phone is moved the levels of signal strength fluctuation change. For example, Figure 3 shows the total signal strength

fluctuation across all monitored cells during successive 30-second time periods whilst walking, remaining still and travelling in a car. The figure illustrates that it is relatively easy to distinguish between moving and remaining stationary but, at times, the pattern of fluctuation whilst walking will match that of driving and vice versa. This is due to the stop–start nature of both walking and travelling in a car in urban areas. When driving, a greater geographical distance will typically be covered over a given time period when compared to that of running or walking. As such it is possible to use the rate of change of neighbouring cells to infer travel by car.

To classify these patterns an artificial neural network is used. The network inputs are: the sum of signal strength fluctuation across all monitored cells and the number of distinct cells monitored over a given time interval. The network consists of a single layer of eight hidden neurons; weights are learnt using back propagation. The network outputs the currently sensed activity for the given input values. The network is trained by repeatedly presenting data collected during each method of movement.

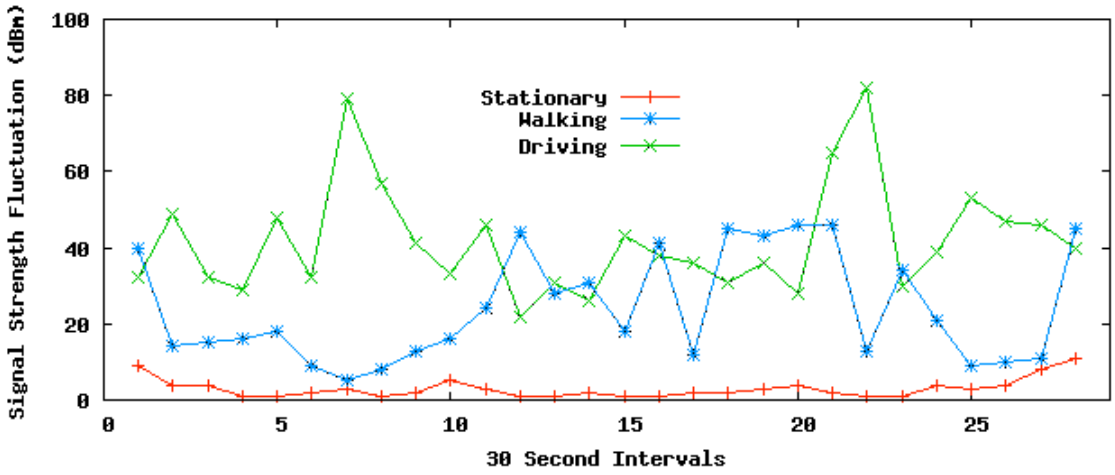

Figure 11-2: GSM Patterns for Stationary, Walking and Driving Activity

The current activity of the user is conditionally dependent upon their previous activity. In order to provide instant feedback to the user interface, the neural network deliberately does not model this behaviour. Instead, when determining if any additional minutes have been learned, we apply task knowledge based upon the output from the neural network over the previous two and a half minutes. This enables noise to be filtered out and a more accurate representation of the users' activities achieved. For example, periods of low signal strength fluctuation such as stopping at traffic lights whilst driving can be ignored when placed between periods of high fluctuation where many distinct neighbouring cells were

monitored. It could be argued that activity would be more accurately inferred if a longer rolling filter had been applied to the GSM data. Introducing longer filters would have increased the likelihood of active minutes 'disappearing' from the users' activity totals. A decision was made that for the purpose of this study priority would be given to user experience; with the intention that this trade-off would be addressed in future work.

11.2 Motivational Issues Survey Overview

Method	#Participants	Recruitment	Data Collection	Analysis
online questionnaire	50	email to student mailing list, blue collar company, poster in public spaces	questionnaire responses	descriptive statistics
Interview (~30mins)	9	invitation at end of questionnaire	audio recording	thematic analysis

Table 11-1: MIS Methods

Participant	Gender	Age	Occupation	Physical Activity
1	male	24	engineer	gym, football
2	male	46	sales trainer	normal
3	male	23	chef	rock climbing
4	male	24	student	territorial army, running, gym
5	female	49	administrator	exercise classes
6	female	31	nurse	exercise class, gym
7	female	54	administrator	running, gym
8	male	38	student	cycling, running, climbing, horse riding
9	male	24	IT developer	gym, swimming
10	female	32	student	rock climbing, running, cycling

Table 11-2: MIS Interview Sociodemographics

11.2.1 Questionnaire

Exercise Questionnaire

We are performing research into people's exercise habits. We are interested in the motivation behind any exercise that is done, as well as any potential or existing obstacles to that motivation.

This is a completely confidential questionnaire and responses will only be used for the purpose of our reserch.

About You

Gender:
- ○ Male
- ○ Female

Age:
- ○ Under 18
- ○ 18-24
- ○ 25-34
- ○ 35-45
- ○ 45-60
- ○ 60+

Everyday Activity

How physically active would you say you are on a day to day basis?
- ○ Extremely
- ○ Very
- ○ Quite
- ○ Not

Do you stick to any form of fitness routine/weekly plan e.g. Yoga on Tuesdays, Gym on Fridays etc?
- ○ Yes
- ○ No
- ○ I try to but don't always keep to it

What are the main sources of your everyday activity?
- ☐ Job
- ☐ Commuting
- ☐ Housework
- ☐ Dog Walking
- ☐ Playing Sport
- ☐ Exercise e.g. gym, swim etc.
- ☐ Other *Please Specify:*

What kind of job do you have?
- ○ Unemployed
- ○ Homemaker

- ○ Student
- ○ Office Worker/Professional
- ○ Outdoors
- ○ Mobile e.g. Driver, Salesperson
- ○ Services e.g. Nurse, Police, Firefighter etc
- ○ Other *Please Specify:*

How do you commute to work/university?

- ☐ Bicycle
- ☐ Car
- ☐ Walk
- ☐ Train
- ☐ Bus

Your Exercise

What would you say are your motivations behind the exercise that you do (please tick all that apply)?

- ☐ Health
- ☐ Fitness
- ☐ Weight Loss
- ☐ Training Regime (for sport/competition)
- ☐ Fun
- ☐ Hobby
- ☐ Socialise
- ☐ Other *Please Specify*

Would you say that you do enough exercise?

- ○ Yes
- ○ No
- ○ Not Quite

If the above answer was no or not quite, what would you say prevents you from doing more exercise?

- ☐ I don't see the point
- ☐ I can't be bothered
- ☐ I don't have the time
- ☐ I don't enjoy it that much
- ☐ I find the gym intimdating
- ☐ Other *Please Specify*

How often do you exercise (not including job-induced activity)?

- ○ Less than once a week
- ○ Once a week

- ○ 2-3 times per week
- ○ 4-5 times per week
- ○ 6+ times per week

What sort of exercise do you do (please tick any that apply)?

- ☐ Gym (Cardiovascular)
- ☐ Weight Lifting
- ☐ Running
- ☐ Walking
- ☐ Hiking
- ☐ Cycling
- ☐ Climbing
- ☐ Swiming
- ☐ Team Sports *Please Specify:*

- ☐ Exercise Classes *Please Specify:*

- ☐ Snow Sports *Please Specify:*

- ☐ Other *Please Specify:*

Where do you exercise(please tick any that apply)?

- ☐ Home
- ☐ Swimming Pool
- ☐ Gym: Cardiovascular Suite
- ☐ Gym: Sports Hall
- ☐ Outside *Please Specify:*

Do you mainly exercise alone or with other people (if you go to the gym, do you *attend* the gym alone)?

- ○ Alone
- ○ With Others
- ○ Both

If you only exercise alone, please answer the next question. otherwise go to question *.
Have you ever considered exercising with friends/family?

- ○ Yes
- ○ No

If so, what is the reason you decided not to?
If not, why not?

What do you feel the benefits are to exercising with others?

Technology Used

If you use any of the following technologies as part of your regular workout, please tick and detail the length of a single session (in minutes), and the number of session repetitions per workout (if applicable).

Machine	Session Length	Number of Reps	It seems time spent on the machine passes...	The exercise is...
☐ Cross Trainer			*slowly* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *quickly*	*stimulating* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *boring*
☐ Step Machine			*slowly* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *quickly*	*stimulating* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *boring*
☐ Treadmill			*slowly* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *quickly*	*stimulating* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *boring*
☐ Rower			*slowly* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *quickly*	*stimulating* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *boring*
☐ Cycle			*slowly* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *quickly*	*stimulating* ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 *boring*

Could you specify any influencing factors over your decision to use one machine over another?

Do you bring any of the following with you to use during exercise (and please state machines/activities that you use them with)?

☐ Book *used with:*

☐ Magazine *used with:*

☐ Portable Music Player *used with:*

☐ Portable Games Console *used with:*

☐ Other *Please Specify*

If so, why?

Would you like to add any comments about the time you spend on anyof the above machinery?

Games

How often do you play computer games?
- Never
- Less than once a week
- 2-3 times per week
- Daily

If your answer was never, please proceed to question *.
If you do play computer games, what sort of games do you prefer?
- Platform
- Shoot 'em up
- Combat
- Strategy
- Other *Please Specify:*

What platform(s) do you use?
- PC
- Arcade
- Playstation/Nintendo/XBox Console
- Handheld Console
- Other *Please Specify:*

If a computer game were available to play during exercise, do you think that it would be some thing that you would be interested in?
- Yes
- No

If not, why not?

Thank You

We are hoping to develop some technology that will aid people's motivation to take part in exercise. This technology may take the form of a game that can be played during exercise or an organisational tool to help people schedule periods of activity into their daily routine. If you have any general comments to make about your experience of motivation and/or organisation, or any initial reactions to the proposed technologies, please write them here:

If you are interested in taking part in further research into this area please leave your name and email address below. Future research may involve a face to face interview and should take no longer than 30 minutes; all interviewees will be rewarded with a £15 Amazon gift voucher. Entering your details below does not commit you to take part in any further studies, it simply registers your interest.

Name: Email:

Thank you for taking the time to fill in this questionnaire.

Submit Questionnaire

11.2.2 Interview Schedule

General:

- Do you exercise on a regular basis?
- How often do you think you exercise?
- How and where do you exercise?
- Why do you exercise?
- Do you ever find it hard to motivate yourself to exercise?
- Why, why not?

Example :

- Tell us about the last time you went to exercise
    - When?
    - Where?
    - What did you do?
    - Was it difficult to start with?
    - How did you feel afterwards?

Exercise as a meaningful activity:

- Do you think exercising is meaningful to you?
- Why, why not?
- Would you exercise more if it was more meaningful to you?
- How could it be more meaningful?

Motivation:

- What are the important factors for you to exercise?
- Can you think of a factor that would motivate you to exercise more?
- Can you think of a factor that would make you stop exercising?

Technology:

- What type of technology do you use for your exercise [important issues here are gym equipment]?
- Do you find that the technologies are motivating?
- If the subject uses gym equipment:
    - What do you use, how often and why?
    - Think of a factor about one of this devices that makes it difficult to exercise
    - Think of a factor that makes it motivating to exercise?
    - Do you listen to music while exercising?

    - Do you watch TV while exercising?
    - Do you find any of this motivating?
        - Tell us about your view of this equipment
- If the person exercise outdoors:
    - Do you listen to music while running/walking?
    - Do you find this motivating?
    - Can you think of other factors that would make this type of exercise more fun?
- If person attends exercise classes:
    - What group activities do you attend?
        - Why?
    - Do you find the group activities motivating?
    - Is there anything you think could make this type of exercise more motivating?

Results:

- Do you think you get the right results from your exercise routine?
- Is there anything you would like to change in your exercise routine?
- Are there any technologies you would like to see in your exercise routine?

11.3 Shakra Study Overview

Method	#Participants	Recruitment	Data Collection	Analysis
pilot study	9	poster in public places	diary	thematic and comparative analysis
			usage logs	descriptive statistics
			interview (~30 mins)	thematic analysis

Table 11-3: Shakra Methods

Participant	Gender	Age	Occupation	Self Declared Activity Level
1	male	54	teacher	fairly inactive
2	female	52	administrator	fairly inactive
3	male	28	technical administrator	moderate
4	male	29	technical administrator	highly
5	male	30	technical administrator	moderate
6	female	19	student	moderate
7	female	37	manager	moderate
8	female	32	administrator	highly
9	female	28	administrator	inactive

Table 11-4: Shakra Sociodemographics

11.3.1 Interview Schedule

- General Attitudes towards Shakra:
  - What did you think of Shakra?
  - Was it fun to use the application to track your activity?
  - How often did you look at it?
  - Tell me about your week in general and how you managed to use the application

- Barriers to Use:
  - How easily did you fit this into your daily life?
    - What made it easy?
    - What made it difficult?

- User Interface:
  - What do you think about the animations?
  - What do you think about the graphs?
  - Did you have any problems using the application?

- Sensing:
  - Do you think it worked well? Did it indicate your status correctly?
    - If not, was there a particular pattern for when it worked less well?
  - Do you think the application was intrusive?
  - Do you feel the app represented how you see yourself and your level of activity?

- Impact on Physical Activity:
    - How did the application change your daily routine?
        - Give examples…
        - Why, why not?
        - Why do you think the application had that effect?

- Social Aspects:
    - Did you find yourself competing with our friends?
    - How did you feel about others being able to see your minutes of activity?
    - How often did you look and compare to see the other's numbers?
        - Did this encourage you?
    - Did you feel some kind of group attitude?
    - Did you at any point go running or walking together with one of your group members?

- Lasting Impression:
    - What was the best thing about the application?
    - What did you like the least?
    - I know it was difficult to remember it and carry it since it was not your own mobile phone, but if it had been running on that, do you think you would want to continue using this application on a regular basis?
        - Why, why not?
    - How would you describe Shakra to somebody who has never used it?
        - (Is it a Game/Monitoring Device/Fitness App?)

11.4 Weight Management Study Overview

Method	#Participants	Recruitment	Data Collection	Analysis
focus group (~90 mins)	4	posters in public spaces	audio recording	open and focussed coding
semi-structured interviews (30-60 mins)	15			

Table 11-5: WM Methods

Participant	Gender	Age	Marital Status	Occupation	Current BMI Range	Previous BMI Range
1	female	25	boyfriend	waitress	normal	normal
2	male	21	single	student	normal	obese
3	female	50	married	auxiliary nurse	obese	obese
4	female	48	married	teaching assistant	normal	normal
5	female	45	married	catering assistant	refused	refused
6	female	24	single	student	normal	normal
7	male	74	widower	retired	obese	obese
8	male	50	married	retired (ill health)	obese	obese
9	female	35	married	housewife	refused	refused
10	female	36	divorced	housewife	normal	normal
11	female	34	married		overweight	overweight
12	female	34	married	bank clerk	normal	normal
13	female	27	engaged	sales rep	overweight	obese
14	male	45	married	police officer	overweight	overweight
15	male	38	partner	technical support	overweight	obese
16	male	54	married	technical support	overweight	obese
17	male	23	girlfriend	teaching assistant	overweight	obese
18	male	47	married	manual worker	overweight	obese
19	female	48	married	clerical worker	obese	obese

Table 11-6: WM Sociodemographics

Participant	Current BMI Range	Previous BMI Range	Dietary Strategy?	Physical Activity?	Programme?
1	normal	normal	diet	gym	no
2	normal	obese	reduce intake	gym, sports	no
3	obese	obese	diet		informal
4	normal	normal	plan food	walking	no (previous commercial progs)
5			cut out snacks	walking	informal
6	normal	normal	cut out snacks	home gym	no
7	obese	obese			medics
8	obese	obese			no
9			healthy eating		informal
10	normal	normal	diet	gym	informal
11	overweight	overweight	diet		scottish slimmers
12	normal	normal	weekday diet, plan food	home exercise	informal
13	overweight	obese	diet		cambridge diet
14	overweight	overweight	healthy eating	gym	no
15	overweight	obese	previous diet	gym, cycle	informal
16	overweight	obese	reduce intake	gym	no
17	overweight	obese	reduce intake		no
18	overweight	obese	diet	gym	medic advice and exercise referral scheme
19	obese	obese	diet	gym	weight watchers

Table 11-7: WM Status and Strategies

11.4.1 Interview Schedule

Basic demographics:

- Age, gender
- Occupation
- Family (nuclear/extended/cohabiting etc)
- Current exposure/use of technology

Current status:

- Where would you say you are right now with your weight?
- What would you say drives your current efforts?
- What is your current regime?

Diet:

- What is your current diet regime?
- How long have you been on current diet?
- What prompted you to start?
- How has this diet changed your daily routine, or changed what you do an a day to day basis?
- How do you monitor your dietary intake?

Exercise:

- What is your current exercise regime?
- How long have you been doing that?
- What prompted you to start?

- How has this exercise regime changed your daily routine, or changed what you do an a day to day basis?
- How do you monitor your activity levels?

Progress:
- How do you rate your level of success or failure?
- Can you think of a time when you had a *success*?
  - who was involved
  - what were the causal & motivating factors
  - were there any barriers & how did you overcome them
- Can you think of a time when you had a *failure*
  - who was involved
  - what were the causal & motivating factors
  - what were the barriers & what prevented you from overcoming them

Motivation:
- What are your main motivations to loose weight?
  - why are these things important
  - who made you realise that
  - when
- What are your biggest barriers to loosing weight?
  - why are these things important
  - who is involved
  - when/how

Others:
- Do [strangers/colleagues/friends/family] ever comment on your weight?
  - could you give me some examples
- How do you feel about your current level of support that you receive?
  - from who
  - how do they support/not support you
- Who would you say are the people who are most involved in your attempts to loose weight?
  - positive and negative
  - can you give a typical example of how X is involved
- Can you think of an example when somebody has been particularly:
  - supportive/unsupportive
  - caring/uncaring
  - encouraging
  - bad influence
- Do you have any positive role models?
  - Can you describe them
  - What is your relationship with them
- Can you give an example of when you have given advice to somebody else based on your own experience?
- Apart from a ww meeting or during an interview such as this, how often do you talk about your weight/diets etc?
- How comfortable are you talking about your weight/diet/health [only if they have mentioned health] to other people?

Use of Technology:
- What kinds of technology do you use to monitor your progress?
  - What benefits do they provide?

    - Are there any disadvantages?
- Could you describe your use the internet for:
    - health information
    - support
    - anything else health-related
- If you don't use the internet for any of those things:
    - why not?
- If you do:
    - how could they be improved?

11.5 Families at Risk Study Overview

Method	#Participants	Recruitment	Data Collection	Analysis
focus group (~90 mins)	3	invitations to users of community outreach project	audio recording	open and focussed coding
semi-structured interviews (45-60 mins)	14			

Table 11-8: FAR Methods

Participant	Age	Marital Status	Work	Occupation	Children	Helpers
1	26	single	FT	sales associate	4 (3-10yrs)	4
2	20	single	No	NA	2 (3,5 yrs)	1
3	54	single	No	cares for mother	3 (8-16yrs)	0
4	27	married	PT	personal banker	3 (5-11yrs)	1
5	31	single	FT	medicaid rep	4 (6-10yrs)	2
6	26	single	FT	medical assistant	2 (6,9yrs)	2
7	26	single	No	NA	2 (6,7yrs)	0
8	29	single	No	NA	3 (8-12yrs)	2
9	25	single	No	NA	3 (2-9yrs)+1*	0
10	29	single	PT	cleaner	4 (4-10yrs)	1
11	28	single	No	NA	2 (6,10yrs)	1
12	28	single	FT	McDonalds	2 (5,7yrs)	1
13	56	single	No	NA	3 (0-9yrs)	1
14	32	engaged	No	babysit	3 (5-10yrs)	1
fg1	34	married	FT	cake decorator	5 (3-12yrs)	1
fg2	46	married	FT	sales associate	2 (7,10yrs)	1
fg3	31	single	FT	janitor	3 (6-13yrs)	4

Table 11-9: FAR Sociodemographics

*****Participant 9 was 7 months pregnant at time of study.*

Participant	Dietary Stage of Change	Children Active Enough?	Caregiver Active?
1	maintenance	yes	yes
2	maintenance	yes	no
3	contemplation	yes	no
4	N/A	yes	no
5	precontemplation	yes	no
6	forced precontemplation	no	yes
7	forced precontemplation	yes	no
8	maintenance	yes	yes
9	action	yes	no
10	preparation	no	no
11	precontemplation	yes	yes
12	maintenance	yes	yes
13	forced precontemplation	yes	no
14	precontemplation	yes	no
fg1	forced precontemplation	yes	no
fg2	forced precontemplation	yes	no
fg3	precontemplation	no	no

Table 11-10: FAR Behavioural Status

11.5.1 Interview Schedule

Basic demographics:

- Age, gender
- Occupation
- Family (nuclear/extended/cohabiting etc)
- Current exposure/use of technology

How important is health? (own & children's)

- What does health mean to you?
- Is it a concern?
- Is it a priority?
- How often do you think about health?

Own health-related behaviours (exercise & diet):

- Positive/negative behaviours
- Previous attempts to change
  - Success/failure
- Friend/family involvement
  - How were they involved
  - Who initiated involvement
  - How much do you share
  - Is there anything that you keep to yourself
- Positive/negative aspects of family involvement

Children's health-related behaviours (exercise & diet):

- Positive/negative behaviours
- Previous attempts to change
    - Success/failure
- Parent's role
- Friend/family involvement
    - How were they involved
    - Who initiated involvement
    - Is there anything that you keep to yourself
- Positive/negative aspects of family involvement

Barriers to making positive change:

- Personal
- Enabling/disabling social influences
- Community
- Society

11.6 Cardiac Rehabilitation Study Overview

Method	#Participants	Recruitment	Data Collection	Analysis
technology probe	2	invitations to cardiac rehabilitation participants	usage logs	descriptive statistics
			interviews (~60 mins)	open and focussed coding
interview (~60 mins)	19		audio recording	open and focussed coding

Table 11-11: CR Methods

Participant	Gender	Age	Marital Status	Children	Occupation
1	*male*	*71*	*married*	*3*	*retired executive*
2	*male*	*50*	*partner*	*0*	*clinical consultant*
30	male	53	married	2: 1 collocated	medical engineer
31	female	77	widow	6	retired nurse
32	male	66	married	3	retired milkman
33	male	60	married	1	social work trainer
34	female	78	widow	2	retired kilt maker
35	male	55	married	3	fork-lift driver
36	male	58	married	2: 1 collocated	quality engineer
37	male	63	married	4	unemployed
38	male	48	partner	1: aged 15 shared custody	IT
39	male	47	married	2: aged 4 and 9	works on roads
40	male	69	partner	3	retired probation worker
41	female	57	married	4	runs a stable
42	female	65	widow	2:	retired cleaner
43	male	43	married	1	entrepreneour
44	male	64	married	2	ex policeman, now janitor
45	male	74	married	4: strained relationships	retired scaffolder
46	male	62	married	3: 1 estranged	taxi operator
47	female	48	partner	1	shop worker
48	male	69	married	2: both collocated	retired manager

Table 11-12: CR Sociodemographics

Participant	Diagnosis	Treatment	Medical History	Family History
1	*angina*	*bypass*	*hypertension, hyperlipidemia*	
2	*mi*	*meds*	*mi, hypertension*	
30	mi	meds		CHD, cholesterol
31	angina	meds	lupus	
32	mi	2*stent		
33	mi	stent	IBS	
34	angina	3*bypass	diabetes	CHD, CVD
35	angina	stent	cholesterol, asthma, arthritic knees	CHD
36	mi	stent		CHD
37	mi	meds		CHD
38	mi	stent		CHD
39	mi	stent		
40	angina	3*stent	emphysema, cholesterol	
41	angina	stent	tia	
42	mi	stent		CHD
43	mi	3*bypass		CHD
44	angina	2*bypass	cholesterol, bp	
45	angina	stent	cholesterol, prostate	CVD
46	mi	meds	obese, type 2 diabetes	
47	mi	stent		CHD
48	mi	2*stent		CHD

Table 11-13: CR Clinical Details and Physiological Risk Factors

Participant	Dietary Intake	Physical Activity	Smoke	Alcohol
1	*minor changes (eats healthy)*	*phase 4, daily walks, swim and gym*	*no*	*occasional*
2	*minor changes (eats healthy)*	*gym*	*no*	*occasional*
30	cut out snacking, want to cut out fat	phase 4, swim	ex	Rarely
31	cut butter, reduce portions	phase 4, something else?	ex	martini
32	total change	phase 4, daily walks	quit	reduced
33	no changes (healthy)	phase 4, daily walks	no	occasional
34	more fruit, more brown bread	phase 4, daily walks	no	rarely
35	healthy eating, fresh food, brown bread, no butter	phase 4, daily walk	ex	18 pints (w/end)
36	minor changes (eats healthy)	phase 4, dog walk, swimming	no	rarely
37	reduction rather than cessation	phase 4, daily walk, swim?	cut to 5	occasional
38	cut out takeaways, cut out fat, more fruit and veg	phase 4, gym, walking	no	cut out alcohol
39	relapsed	phase 4?, golf, walking	cut to 5	5 pints (twice a week)
40	modified diet, cooking practices, more veg, fruit juice	phase 4, everyday activity	ex	occasional
41	reduced fat intake	phase 4, water aerobics	ex	nil
42	minor changes (eats healthy)	phase 4, walking club?	quit	rarely
43	unchanged (healthy)	phase 4 (until fit)	quit	2-20 pints (w/end)
44	unchanged (healthy)	normally active	no	reduced
45	minor changes (eats healthy)	phase 4?, normally active	no	~30 spirits (weekly)
46	reduce portions, cut out snacks	phase 4	no	occasional
47	reduced fat intake	phase 4?	20 a day	rarely
48	changed meals and cutting out snacking, toast is a problem	phase 4, daily walks	no	rarely

Table 11-14: CR Behavioural Risk Factors

11.6.1 Interview Schedule

Basic demographics:

- Age, gender
- Occupation
- Family (nuclear/extended/cohabiting etc)
- Current exposure/use of technology

Clinical information:

- Current cardiac condition
- Drug regime
- Clinical Investigations
- Core morbidities?
- Family history

Health/condition-related behaviours (pre cardiac event):

- Positive/negative behaviours
- Previous attempts to change
    - Success/failure
- Friend/family involvement
    - How were they involved
    - Who initiated involvement
    - How much do you share
    - Is there anything that you keep to yourself
- Positive/negative aspects of family involvement

Cardiac Event:

- Friend/Family involvement
    - How were they involved
    - Who initiated involvement
    - How much do you share
    - Is there anything that you keep to yourself

Health/condition-related behaviours:

- What changes were necessary?
- Who do they think helped/hindered them the most?
- Friend/Family involvement
    - How much did you share
    - Is there anything that you kept to yourself?
- Are there any more changes that you would like to make?

Cardiac Rehab:

- Could you describe your experience of the rehab program?
- How have your peers been involved with your rehab?
    - Examples of involvement…
- Most influential person during your rehabilitation
    - How have they been influential?
- If the answer to the above was a health professional, then ask: out of your friends and family, who has been the most influential person during your rehabilitation?
    - How have they been influential?

Peer Involvement:

- Examples of instances of specific types peer involvement, for example:
  - Social support
    - Listening
    - Assistance
    - Encouragement
    - Agreement
  - Social control
    - Prompting
    - Trying to influence choices
    - Instructing
    - Preventing
- Examples of instances of involvement from specific peers, for example:
  - Friends
  - Family
  - Other rehab participants
  - Health professionals

Use of Technology:

- What kinds of technology do you use to monitor your progress?
  - What benefits do they provide?
  - Are there any disadvantages?
- Could you describe your use the internet for:
  - health information
  - support
  - anything else health-related
- If you don't use the internet for any of those things:
  - why not?
- If you do:
  - how could they be improved?

12 References

1 Ackerman, M.: ‘The Intellectual Challenge of CSCW: The Gap Between Social Requirements and Technical Feasibility’, Human Computer Interaction, 2000, 15, (2-3), pp. 179-204

2 Ackerman, M., Huysman, M., Carroll, J.M., Wellman, B., DeMichelis, G., and Wulf, V.: ‘ Communities and technologies: an approach to foster social capital? ’. Proc. 2004 ACM conference on Computer supported cooperative work, Chicago, 2004, ACM, pp. 406-408

3 Adams, J., and White, M.: ‘Why don't stage-based activity promotion interventions work?’, Health Education Research, 2005, 20, (2), pp. 237-243

4 Ajzen, I.: ‘The theory of planned behaviour’, Organizational Behaviour and Human Decision Processes 1991, 50, pp. 179-211

5 Ajzen, I.: ‘Perceived Behavioural Control, Self-Efficacy, Locus of Control, and the Theory of Planned Behavior’, Journal of Applied Social Psychology, 2002, 32, (4), pp. 665-683

6 American Heart Association: ‘Heart disease and stroke statistics - 2008 update’, 2008

7 Amft, O., Stager, M., Lukowicz, P., and Troster, G.: ‘Analysis of Chewing Sounds for Dietary Monitoring’. Proc. 7th International Conference on Ubiquitous Computing, 2005, Springer, pp. 56-72

8 Ammerman, A., S., Lindquist, C., H., Lohr, K., N., and Hersey, J.: ‘The Efficacy of Behavioral Interventions to Modify Dietary Fat and Fruit and Vegetable Intake: A Review of the Evidence’, Preventive Medicine, 2002, 35, pp. 25-41

9 Anderson, A., Cohn, L., and Holbrook, T.: ‘Making Weight: Men's Conflicts with Food, Weight, Shape and Appearance’ (Gurze Books, 2000)

10 Anderson, I., Maitland, J., Sherwood, S., Barkhuus, L., Chalmers, M., Hall, M., Brown, B., and Muller, H.: ‘Shakra: Tracking and Sharing Daily Activity Levels with Unaugmented Mobile Phones’, MONET Journal Special Edition on Pervasive Health Technologies, 2007, 12, (2-3), Springer, pp. 165-199

11 Anderson, I., and Muller, H.: ‘Context Awareness via GSM Signal Strength Fluctuation. Late Breaking Results.’,Proc. 4th International Conference on Pervasive Computing, Dublin, 2006, Springer, pp. 27-31

12 Arrigo, I., Brunner-LaRocca, H., Lefkovits, M., Pfisterer, M., and Hoffmann, A.: ‘Comparative outcome one year after formal cardiac rehabilitation: the effects of a randomized intervention to improve exercise adherence. ’, European Journal of Cardiovascular Prevention & Rehabilitation, 2008, 15, (3), pp. 306-311

13 Arthur, H.M.: ‘Depression, isolation, social support, and cardiovascular disease in older adults.’, Journal of Cardiovascular Nursing, 2006, 21, (55), pp. 52-57

14 Arthur, H.M., Wright, D.M., and Smith, K.M.: ‘Women and heart disease: the treatment may end but the suffering continues’, Canadian Journal of Nursing Research, 2002, 33, (3), pp. 17-29

15 Astin, F., Atkin, K., and Darr, A.: ‘Family support and cardiac rehabilitation: A comparative study of the experiences of South Asian and White-European patients and their carers living in the United Kingdom’, European Journal of Cardiovascular Nursing., 2008, 7, pp. 43-51

16 Baker, J.P., Bones, P.J., and Lim, M.A.: ‘Wireless Health Monitor’. Proc. Electronics New Zealand Conference, 2006, Christchurch, New Zealand, 2006 , pp. 7-12

17 Bandura, A.: ‘Social Learning Theory’ (General Learning Press, 1977)

18 Bandura, A.: ‘Social Foundations of Thought and Action: A Social Cognitive Theory.’ (Prentice Hall, 1986)

19 Bandura, A.: ‘Self-efficacy: Thought control of action’ (Freeman, 1994. 1994)

20 Barak, A., Boniel-Nissim, M., and Suler, J.: 'Fostering empowerment in online support groups', Computers in Human Behavior, 2008, 24, pp. 1867-1883

21 Bardram, J.E., Mihailidis, A., and Wan, D.: 'Pervasive Computing in Healthcare' (CRC Press, 2006)

22 Barkhuus, L.: 'The Context Gap: An Essential Challenge to Context-Aware Computing', Unpublished Thesis, IT University of Copenhagen, 2004, http://www.itu.dk/people/barkhuus/lou_thesis5.pdf [last accessed 27/5/09]

23 Barkhuus, L., and Rode, J.: 'From Mice to Men - 24 years of Evaluation in CHI'. Proc. Alt.CHI, 2007, http://www.itu.dk/people/barkhuus/barkhuus-altchi.pdf [last accessed 27/5/09]

24 Barton, A., J., Gilbert, L., Baramee, J., and Granger, T.: 'Cardiovascular risk in hispanic and non-hispanic preschoolers.', Nursing Research, 2006, 55, pp. 172-179

25 Bell, G., and Dourish, P.: 'Yesterday's tomorrows: notes on ubiquitous computing's dominant vision', Personal Ubiquitous Computing, 2006, 11, (2), pp. 133-143

26 Bell, M.: 'Guidelines and infrastructure for the design and implementation of highly adaptive, context-aware, mobile, peer-to-peer systems', Unpublished Thesis, University of Glasgow, 2007, http://www.marekbell.com/files/thesis.pdf [last accessed 27/5/09]

27 Bell, M., Chalmers, M., Barkhuus, L., Hall, M., Sherwood, S., Tennent, P., Brown, B., Rowland, D., Benford, S., and Hampshire, A.: 'Interweaving Mobile Games with Everyday Life'. Proc. SIGCHI conference on Human Factors in computing systems, 2006, ACM, pp. 417-426

28 Bellotti, V., and Sellen, A.: 'Design for privacy in ubiquitous computing environments'. Proc. third conference on European Conference on Computer-Supported Cooperative Work, Milan, Italy, 1993, Kluwer, pp. 75-90

29 Benford, S., and Fahlen, L.: 'A Spatial Model of Interaction in Large Virtual Environments'. Proc. third conference on European Conference on Computer Supported Cooperative Work, Milan, Italy 1993, Kluwer, pp. 107-132

30 Berkman, L., and Glass, T.: 'Social integration, social support, and health.', in Berkman, L., and Kawachi, I. (Eds.): 'Social Epidemiology' (Oxford University Press, 2000)

31 Bers, M.U., Gonzalez-Heydrich, J., and DeMaso, D.R.: 'Identity construction environments: supporting a virtual therapeutic community of pediatric patients undergoing dialysis '. Proc. SIGCHI conference on Human factors in computing systems Seattle, Washington, 2001, ACM, pp. 380-387

32 Bickmore, T., Caruso, L., Clough-Gorr, K., and Heeren, T.: 'It's just like you talk to a friend', HCI and the Older Population, 2005, 17, (6), pp. 711-735

33 Bidargaddi, N., and Sarela, A.: 'Ambulatory monitor derived clinical measures for continuous assessment of cardiac rehabilitation patients in a community care model'. Proc. Pervasive Health, 2008, IEEE, pp. 232-236

34 Biddle, S.J.H., and Mutrie, N.: 'Psychology of physical activity' (Routledge, 2001)

35 Biddle, S.J.H., and Mutrie, N.: 'Psychology of physical activity: determinants, well-being and interventions' (Routledge, 2002)

36 Bjorgaas, M.R., Vik, J.T., Stolen, T., Lydersen, S., and Grill, V.: 'Regular use of pedometer does not enhance beneficial outcomes in a physical activity intervention study in type 2 diabetes mellitus', Metabolism, 2008, 57, (5), pp. 605-611

37 Blair, S., N. , and Church, T., S.: 'The Fitness, Obesity, and Health Equation: Is Physical Activity the Common Denominator?', JAMA, 2004, 292, pp. 1232-1234

38 Bloor, M., Frankland, J., Thomas, M., and Robson, K.: 'Focus Groups in Social Research' (SAGE Publications, 2001)

39 Blumer, H.: ‘Symbolic Interactionism: Perspective and Method’ (University of California Press, 1969)

40 Bordo, S.: ‘Unbearable Weight: feminism, Western culture, and the body’ (University of California Press, Ltd., 2003)

41 Borg, G.: ‘Borg's perceived exertion and pain scales’ (Human Kinetics, 1998)

42 Bourdieu, P.: ‘The Forms of Capital.’, in Richardson, J., G. (Ed.): ‘Handbook of Theory and Research for the Sociology of Education’ (1986), pp. 241–258

43 Braithwaite, R.L., Bianchi, C., and Taylor, S.E.: ‘Ethnographic approach to community organization and health empowerment. ’, Health Education Quarterly, 1994, 21, (3), pp. 407-416

44 Breinbauer, C., and Maddaleno, M.: ‘Youth: Choices and Change’, (Pan American Health Organisation, 2005)

45 Brinkerhoff, D.B.: ‘Essentials of Sociology’ (Wandsworth, 2004)

46 British Heart Foundation: ‘Coronary Heart Disease Statistics’, 2005

47 Brooks, Y., Black, D.R., Coster, D.C., Blue, C.L., Abood, D.A., and Gretebeck, R.J.: ‘Body Mass Index and Percentage Body Fat as Health Indicators for Young Adults’, American Journal of Health Behaviour, 2007, 31, (6), pp. 687-700

48 Brown, B., Taylor, A., Izadi, S., Sellen, A., and Kaye, J.: ‘Locating family values: A field trial of the Whereabouts Clock’. Proc. 9th international Conference on Ubiquitous Computing, Innsbruck, Austria, 2007, Spinger, pp. 354-371

49 Browning, C., J., and Thomas, S., A.: ‘Behavioural Change: An Evidence-based Handbook for Social and Public Health’ (Elsevier Churchill Livingston, 2005)

50 Browning, C., J., and Thomas, S., A.: ‘Models of behaviour change and health promotion’, in Browning, C., J., and Thomas, S., A. (Eds.): ‘Behavioural Change: An Evidence-based Handbook for Social and Public Health’ (Elsevier Churchill Livingston, 2005), pp. 7-16

51 Brug, J., Oenema, A., Kroeze, W., and Raat, H.: ‘The internet and nutrition education: challenges and opportunities.’, European Journal of Clinical Nutrition, 2005, 59, (Suppl 1), pp. s130-139

52 Bunker, S.J., Colquohoun, D.M., and Murray, D.E.: ‘Stress and coronary heart disease-psychosocial risk factors: National Heart Foundation of Australia Position Statement Update’, Medical Journal of Australia, 2003, 178, pp. 272-276

53 Burdette, H., L., and Whitaker, R., C.: ‘Resurrecting free play in young children: looking beyond fitness and fatness to attention, affiliation, and affect’, Archives of Pediatric and Adolescent Medicine, 2005, 159, pp. 46-50

54 Butterfoss, F.D., and Kegler, M.C.: ‘Toward a comprehensive understanding of community coalitions. Moving from practice to theory.’, in DiClemente, R.J., Crosby, R.A., and Kegler, M.C. (Eds.): ‘Emerging Theories in Health Promotion Practice and Research. ’ (Jossey-Bass, 2002)

55 Campbell, K., J., and Hesketh, K., D.: ‘Strategies which aim to positively impact on weight, physical activity, diet and sedentry behaviours in children from zero to five years. A systematic review of the literature.’, Obesity Reviews, 2007, (8), pp. 327-338

56 Carlson, J.J., Norman, G.J., Feltz, D.L., Franklin, B.A., Johnson, J.A., and Locke, S.K.: ‘Self-efficacy, psychosocial factors, and exercise behavior in traditional versus modified cardiac rehabilitation’, Journal of Cardiopulmonary Rehabilitation, 2001, 21, (6), pp. 363-373

57 Carpiano, R., M.: ‘Toward a neighborhood resource-based theory of social capital for health: Can Bourdieu and sociology help?’, Social Science & Medicine, 2005, (62), pp. 165-175

58 Chamberlain, A., Benford, S., Greenhalgh, C., Hampshire, A., Tandavanitj, N., Adams, M., Oldroyd, A., and Sutton, J.: 'Professor Tanda: greener gaming and pervasive play'. Proc. 2007 conference on Designing for User eXperiences, Chicago, Illinois, 2007 , ACM, pp. 1-7

59 Chan, C., Ryan, D., and Tudor-Locke, C.: 'Health benefits of a pedometer-based physical activity intervention in sedentary workers ', Preventive Medicine, 2004, 39, pp. 1215-1222

60 Chandler, D.: 'Technological or Media Determinism', 1995, http://www.aber.ac.uk/media/Documents/tecdet/tecdet.html [last access 27/02/09]

61 Chang, K.-h., Liu, S.-y., Chu, H.-h., Hsu, J.Y.-j., Chen, C., Lin, T.-y., Chen, C.-y., and Huang, P.: 'The Diet-Aware Dining Table: Observing Dietary Behaviours over a Tabletop Surface'. Proc. 6th International Conference on Pervasive Computing, Dublin, Republic of Ireland, 2006, Springer, pp. 366-382

62 Chi, P., Chan, J., Chu, H., and Chen, B.: 'Enablling Nutrition-Aware Cooking in a Smart Kitchen', Proc. CHI '07 extended abstracts on Human factors in computing systems, 2007, ACM, pp. 2333-2338

63 Chi, P., Chen, J., Chu, H.-h., and Lo, J.: 'Enabling Calorie-Aware Cooking in a Smart Kitchen'. Proc. 3rd International Conference on Persuasive Computing, Oulu, Finland, 2008, Springer, 116-127

64 Chiuve, S., E., and Willett. W., C.: 'The 2005 Food Guide Pyramid: an opportunity lost?', Nature Clinical Practice Cardiovascular Medicine, 2007, 4, (11), pp. 610-620

65 Choudrey, T., Borriello, G., Consolvo, S., Haehnel, D., Harrison, B., Hemingway, B., Hightower, J., Klasnja, P., Koscher, K., LaMarca, A., Lester, J., Landay, J.A., Legrand, L., Rahimi, A., Rea, A., and Wyatt, D.: 'The Mobile Sensing Platform: An Embedded System for Capturing and Recognizing Human Activities', IEEE Pervasive Computing, 2008, 7, (2) pp. 32-41

66 Chronister, J., A., Johnson, E., K., and Berven, N., L.: 'Measuring social support in rehabilitation', Disability and Rehabilitation, 2006, 28, (2), pp. 75-84

67 Chung, H., and Myers, S., L. Jr: 'Do the Poor Pay More for Food? An Analysis of Grocery Store Availability and Food Price Disparities ', Journal of Consumer Affairs, 1999, 33, (2), pp. 276-296

68 Church, T.S., LaMonte, M.J., Barlow, C.E., and Blair, S.N.: 'Cardiorespiratory Fitness and Body Mass Index as Predictors of Cardiovascular Disease Mortality Among Men With Diabetes', Archives of Internal Medicine, 2005, 165, (18), pp. 2114-2120

69 Cockton, G.: 'Value-centred HCI'. Proc. Proceedings of the third Nordic conference on Human-computer interaction, Tampere, Finland, 2004, ACM, pp. 149-160

70 Condon, C., and McCarthy, G.: 'Lifestyle changes following acute myocardial infarction: Patients perspectives', European Journal of Cardiovascular Nursing., 2006, 5, pp. 37-44

71 Connelly, K., H., Faber, A., Rogers, Y., Siek, K., A., and Toscos, T.: 'Mobile Applications that Empower People to Monitor their Personal Health.', Springer e&i, 2006, 123, (4), pp. 124

72 Consolvo, S., Everitt, K., Smith, I., and Landay, J.: 'Design Requirements for Technologies that Encourage Physical Activity'. Proc. SIGCHI conference on Human Factors in computing systems, Montreal, Canada, 2006, ACM, pp. 457-466

73 Consolvo, S., Klasnja, P., McDonald, D.W., Avrahami, D., Froehlich, J., LeGrand, L., Libby, R., Mosher, K., and Landay, J.A.: 'Flowers or a robot army? Encouraging awareness and activity with personal, mobile displays'. Proc. 10th international conference on Ubiquitous computing, Seoul, Korea, 2008, ACM, 54-63

74 Consolvo, S., McDonald, D., W., Toscos, T., Chen, M., Y., Froehlich, J., Harrison, B., Klasnja, P., LaMarca, A., LeGrand, L., Libby, R., Smith, I., and Landay, J., A.: 'Activity

sensing in the wild: a field trial of ubifit garden'. Proc. SIGCHI conference on Human Factors in computing systems, Florence, Italy, 2008, ACM, pp. 1797-1806

75 Crabtree, A., and Rodden, T.: 'Domestic Routines and Design for the Home', CSCW, 2004, 13, (2), pp. 191-220

76 Davis, R., Cook, D., and Cohen, L.: 'A community resilience approach to reducing ethnic and racial disparities in health', American Journal of Public Health, 2005, 95, (12), pp. 2168-2173

77 Davis, R., and Turner, L.W.: 'A review of current weight management: research and recommendations', Journal of the American Academy of Nurse Practitioners, 2001, 13, (1), pp. 15-19

78 Dawe, M.: 'Desperately seeking simplicity: how young adults with cognitive disabilities and their families adopt assistive technologies'. Proc. SIGCHI conference on Human Factors in computing systems, Montreal, Canada, 2006, ACM, pp.1143-1152

79 De Cocker, K., Cardon, G., and De Bourdeaudhuij, I.: 'The validity of the inexpensive 'Stepping Meter' in counting steps in free-living conditions: a pilot study.', British Journal of Sports Medicine, 2006, **40**, pp. 714-716

80 Department for Media Culture and Sport: 'Sporting Britain', 2004

81 Department of Health: 'The expert patient. A new approach to chronic disease management for the 21st century', 2001

82 Department of Health: 'At least five a week: evidence on the impact of physical activity and its relationship to health', 2004

83 Department of Health: 'Choosing Health: Making healthy choices easier', 2004

84 Dickerson, S.S.: 'Cardiac spouses' help-seeking experiences', Clinical Nursing Research, 1998, 7, (1), pp. 6-24

85 Dixon, H., and Paxton, S.: 'Eating and nutrition', in Browning, C., J., and Thomas, S., A. (Eds.): 'Behavioural Change: An Evidence-based Handbook for Social and Public Health' (Elsevier Churchill Livingston, 2005), pp. 45-68

86 Dobson, R.: 'Smoking bans reduce heart attack admissions', BMJ, 2008, 337, pp. a597

87 Donnelly, J., E., Smith, B., Jacobsen, D., J., Kirk, E., Dubose, K., Hyder, M., Bailey, B., and Washburn, R.: 'The role of exercise for weight loss and maintenance', Best Practice & Research in Clinical Gastroenterology, 2004, 18, (6), pp. 1009-1029

88 Dourish, P.: 'Responsibilities and implications: further thoughts on ethnography and design'. Proc. 2007 conference on Designing for User eXperiences, Chicago, Illinois, 2007, ACM, pp. 2-16

89 Dunbar, R., and Spoors, M.: 'Social Networks, support cliques and kinship', Human Nature, 1995, 6, pp. 273-290

90 Dwyer, J., Picciano, M., and Raiten, D.: 'Estimation of Usual Intakes: What We Eat in America-NHANES', Journal of Nutrition, 2003, 133, (2), pp. 609S-623S

91 Edwards, R.: 'The problem of tobacco smoking', BMJ, 2004, 328, pp. 217-219

92 Elfhag, K., and Rossner, S.: 'Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain', Obesity Reviews, 2005, 6, (1), pp. 67-85

93 Engel, L., and Lindner, H.: 'Impact of using a pedometer on time spent walking in older adults with type 2 diabetes', Diabetes Education, 2006, 32 pp. 98-107

94 Eysenbach, G., Powell, J., Englesakis, M., Rizo, C., and Stern, A.: 'Health related virtual communities and electronic support groups: systematic review of the effects of online peer to peer interactions ', BMJ, 2004, 328, pp. 1166-1171

95 Farnham, S., Cheng, L., Stone, L., Zaner-Godsey, M., Hibbeln, C., Syrjala, K., Clark, A.M., and Abrams, J.: 'HutchWorld: clinical study of computer-mediated social support for cancer patients and their caregivers '. Proc. SIGCHI conference on Human factors in computing systems, Minneapolis, Minnesota, 2002, ACM, pp. 375-382

96 Festinger, L.: 'A Theory of Social Comparison Processes', Human Relations, 1954, 7, pp. 117-140

97 Fishbein, M.: 'Predicting, understanding, and changing socially relevant behaviours: lessons learned', in McGarty, C., and Haslam, A. (Eds.): 'The Message of Social Psychology: Perspectives on Mind in Society' (Blackwell Publishers, 1997), pp. 77-91

98 Fogg, B., J.: 'Persuasive Technology: Using Computers to Change What We Think and Do' (Morgan Kaufmann, 2003)

99 Fox, N., J., Ward, K., J., and O'Rourke, A., J.: 'The 'expert patient': empowerment or medical dominance? The case of weight loss, pharmaceutical drugs and the Internet', Social Science & Medicine, 2005, 60, (6), pp. 1299-1309

100 Franks, M.M., Stephens, M.A.P., Rook, K.S., Franklin, B.A., Keteyian, S.J., and Artinian, N.T.: 'Spouses' provision of health-related support and control to patients participating in cardiac rehabilitation.', Journal of Family Psychology., 2006, 20, (2), pp. 311-318

101 Frost, J., and Smith, B., K.: 'Visualizing Health: Imagery in Diabetes Education'. Proc. 2003 conference on Designing for User eXperiences, 2003, ACM, pp. 1-14

102 Fujinami, K., and Riekki, J.: 'A Case Study on an Ambient Display as a Persuasive Medium for Exercise Awareness'. Proc. 3rd International Conference on Persuasive Technology, Oulu, Finland, 2008, Springer, pp. 226-269

103 Gasser, R., Brodbeck, D., Degan, M., Luthiger, J., Wyss, R., and Reichlin, S.: 'Persuasiveness of a Mobile Lifestyle Coaching Application using Social Facilitation'. Proc. 1st International Conference on Persuasive Computing, 2006, Springer, pp. 27-38

104 Gaver, B., Dunne, T., and Pacenti, E.: 'Design: Cultural probes', interactions, 1999, 6, (1), pp. 21-29

105 Gaver, W., Moran, T., MacLean, A., Lovstrand, L., Dourish, P., Carter, K., and Buxton, W.: 'Realizing a video environment: EuroPARC's RAVE system'. Proc. SIGCHI conference on Human factors in computing systems, Monterey, California, 1992, ACM, pp. 27-35

106 Gay, V., and Leijdekkers, P.: 'Around the clock personalized heart monitoring using smart phones'. Proc. Smart Homes and Health Telematics, 2006, IOS Press, pp. 82-89

107 Glaser, B., G.: 'Advances in the Methodology of Grounded Theory' (The Sociology Press, 1978)

108 Godefroid, P., Herbsleb, J.D., Jagadeesany, L.J., and Li, D.: 'Ensuring privacy in presence awareness: an automated verification approach'. Proc. 2000 ACM conference on Computer supported cooperative work, Philadelphia, Pennsylvania, 2000, ACM, pp. 59-68

109 Goecks, J., and Mynatt, E.D.: 'Leveraging social networks for information sharing'. Proc. 2004 ACM conference on Computer supported cooperative work, Chicago, Illinois, 2004, ACM, pp. 328-331

110 Goecks, J., Voida, A., Voida, S., and Mynatt, E.D.: 'Charitable technologies: opportunities for collaborative computing in nonprofit fundraising'. Proc. ACM 2008 conference on Computer supported cooperative work, San Diego, CA, 2008, ACM, pp. 689-698

111 Gorin, A., Phelan, S., Tate, D., Sherwood, N., Jeffrey, R., and Wing, R.: 'Involving support partners in obesity treatment', Journal of Consulting and Clinical Psychology, 2005, 73, (2), pp. 341-343

112 Gough, B.: ''Real men don't diet': An analysis of contemporary newspaper respresentations of men, food and health', Social Science & Medicine, 2007, 64, (2), pp. 326-337

113 Graves, L., Stratton, A., and Ridgers, N.D.: 'Comparison of energy expenditure in adolescents when playing new generation and sedentary computer games: cross sectional study', BMJ, 2007, 335, pp. 1282-1284

114 Greenbaum, T.: 'The Handbook for Focus Group Research' (Thousand Oaks: Sage, 1998)

115 Gregory, J., Collins, D., and Davies, P.: 'National Diet and Nutrition Survey: Children Aged 1 1/2 to 4 1/2 Years', HMSO, 1995,

116 Grimes, A., Bednar, M., Bolter, J.D., and Grinter, R.E.: 'EatWell: sharing nutrition-related memories in a low-income community'. Proc. 2008 ACM conference on Computer supported cooperative work, San Diego, CA, 2008, ACM, pp. 87-96

117 Grimes, A., and Grinter, R., E.: 'Designing Persuasion: Health Technology for Low-Income African American Communities'. Proc. 2nd International Conference on Persuasive Computing, 2007, Springer, pp. 24-35

118 Grzywacz, J.G., and Marks, N.F.: 'Social inequalities and exercise during adulthood: Toward an ecological perspective', Journal of Health and Social Behaviour, 2001, 42, (2), pp. 202-220

119 Hardeman, W., Griffin, S., Johnston, M., Kinmouth, A., L., and Warehanm, N., J.: 'Interventions to prevent weight gain: a systematic review of psychological models and behaviour change methods ', International Journal of Obesity, 2000, 24, pp. 131-143

120 Hartmann-Tews, I., and Pfister, G.: 'Women's inclusion in sport: international and comparative findings', in Hartmann-Tews, I., and Pfister, G. (Eds.): 'Sport and Women: Social Issues in International Perspective' (Routledge, 2002)

121 Harvey-Berino, J., Pintauro, S., Buzzell, P., and Gold, E.C.: 'Effect of internet support on the long-term maintenance of weight loss', Obesity Research, 2004, 12, (2), pp. 320-329

122 Haskell, W., L., Lee, I., Pate, R., R., Powell, K., E., Blair, S., N., Franklin, B., A., Macera, C., A., Heath, G., W., Thompson, P., D., and Bauman, A.: 'Physical Activity and Public Health: Updated Recommendation for Adults from the American College of Sports Medicine and the American Heart Association', Med. Sci. Sports Exerc., 2007, 39, (8), pp. 1423-1434

123 Haughton McNeill, L., Kreuter, M., W. , and Subramanian, S., V.: 'Social Environment and Physical activity: A review of concepts and evidence', Social Science & Medicine, 2006, 63, (4), pp. 1011-1022

124 HealthScotland: 'Profiling Health Behaviours in Scotland using the Health Education Population Survey 1996-99 dataset', 2000

125 Heidegger, M.: 'Being and Time' (Harper & Row, 1962)

126 Hoare, J., and Henderson, L.: 'The National Diet and Nutrition Survey: Adults Aged 19-64 Years', Food Standards Agency, 2004

127 Hogan, B.E., Linden, W., and Najarian, B.: 'Social support interventions. Do they work?', Clinical Psychology Review, 2002, 22, pp. 381-440

128 Hong, T.B., Franks, M.M., Gonzalez, R., Keteyian, S.J., Franklin, B., A., and Artinian, N.T.: 'A dyadic investigation of exercise support between cardiac patients and their spouses', Health Psychology, 2005, 4, pp. 430-434

129 Hoysniemi, J.: 'International Survey on the Dance Dance Revolution game', Computers in Entertainment, 2006, 4, (2), pp. 8-

130 Hutchinson, H., Mackay, W., Westerlund, B., and al, e.: 'Technology Probes: Inspiring Design for and with Families'. Proc. SIGCHI conference on Human Factors in computing systems, 2003, ACM, pp. 17-24

131 Hwang, K.O., Farheen, K., Johnson, C.W., Thomas, E.J., Barnes, A.S., and Bernstam, E.V.: ' Quality of Weight Loss Advice on Internet Forums. ', The American Journal of Medicine, 2007, 120, (7), pp. 604-609

132 Ilarraza, H., Myers, J., Kottman, W., Rickli, H., and Dubach, P.: 'An evaluation of training responses using self-regulation in a residential rehabilitation program.', Journal of Cardiopulmonary Rehabilitation., 2004, 24, (1), pp. 27-33

133 Intille, S., Herigon, J., Haskell, W., King, A., Wright, J.A., and Friedman, R.F.: 'Intensity levels of occupational activities related to hotel housekeeping in a sample of minority women'. Proc. Annual Meeting of the International Society of Behavioral Nutrition and Physical Activity, 2006

134 Izawa, K.P., Watanabe, S., Omiya, K., Hirano, Y., Oka, K., Osada, N., and Iijima, S.: 'Effect of the self-monitoring approach on exercise maintenance during cardiac rehabilitation: a randomized, controlled trial.', American Journal of Physical Medicine & Rehabilitation., 2005, 84, (5), pp. 313-321

135 Jantz, C., Anderson, J., and Gould, S., M.: 'Using computer-based assessments to evaluate interactive multimedia nutrition education among low-income predominantly hispanic participants', Journal of Nutrition Education and Behaviour, 2002, 34, (5), pp. 252-260

136 Jarvinen, P., Jarvinen, T.H., Lahteenmaki, L., and Sogergard, C.: 'Hyperfit: Hybrid Media in Personal Nutrition and Exercise Management'. Proc. Pervasive Health, Tampere, Finland, 2008, IEEE, pp. 222-226

137 Jasemian, Y.: 'Elderly comfort and compliance to modern telemedicine system at home'. Proc. Pervasive Health, Tampere, Finland, 2008, IEEE, pp. 60-63

138 Johnston, C.S.: 'Uncle Sam's diet sensation: MyPyramid--an overview and commentary', Medscape General Medicine, 2005, 7, (3), pp. 78

139 Jovicic, A., Smith, P.W., and Chignell, M.: 'Customizing online education for cardiac patients', ACM eLearn Magazine, 10, 2007

140 Karner, A., Dahlgren, M.A., and Bergdahl, B.: 'Coronary heart disease: causes and drug treatment- spouses' conceptions', Journal of Clinical Nursing, 2004, 13, pp. 167-176

141 Khaled, R., Barr, P., Fischer, R., Noble, J., and Biddle, R.: 'Factoring culture into the design of a persuasive game'. Proc. 18th Australia conference on Computer-Human Interaction: Design: Activities, Artefacts and Environments, Sydney, Australia, 2006, ACM, pp. 213-220

142 Khaled, R., Fischer, R., Noble, J., and Biddle, R.: 'A Qualitative Study of Culture and Persuasion in a Smoking Cessation Game'. Proc. 3rd international conference on Persuasive Technology, Oulu, Finland, 2008, Springer, pp. 224-236

143 Khalil, A., and Connelly, K.: 'Do I Do What I Say?: Observed Versus Stated Privacy Preferences,'. Proc. Eleventh IFIP TC13 International Conference on Human-Computer Interaction, Rio de Janeiro, Brazil, 2007, Springer, pp. 620-623

144 Khuder, S.A., Milz, S., Jordan, T., Price, J., Silvestri, K., and Butler, P.: 'The impact of a smoking ban on hospital admissions for coronary heart disease', Preventive Medicine, 2007, 45, (1), pp. 3-8

145 Krause, N.: 'Longitudinal study of social support and meaning in life', Psychology and Aging, 2007, 22, (3), pp. 456-469

146 Kristofferzon, M.L., Lofmark, R., and Carlsson, M.: 'Myocardial infarction: gender differences in coping and social support', Journal of Advanced Nursing, 2003, 44, (4), pp. 360-374

147 Kuhl, E.A., Sears, S.F., and Conti, J.B.: 'Internet-based behavioral change and psychosocial care for patients with cardiovascular disease: A review of cardiac disease-specific applications', Heart & Lung: The Journal of Acute and Critical Care, 2006, 35, (6), pp. 374-382

148 Kumar, S., Kambhatla, K., Hu, F., Lifson, M., and Xiao, Y.: 'Ubiquitous computing for remote cardiac patient monitoring: a survey', Int. J. Telemedicine Appl., 2008, (4), pp. 1-19

149 Lave, J., and Wenger, E.: ‘Situated Learning: Legitimate Peripheral Participation’ (Cambridge University Press, 1991)

150 Lechner, L., Brug, J., De Vries, H., van Assema, P., and Mudde, A.: ‘Stages of change for fruit, vegetable and fat intake: consequences of misconception’, Health Education Research, 1998, 13, (1), pp. 1-11

151 Lee, G., and Carrington, M.: ‘Tackling heart disease and poverty’, Nursing and Health Sciences, 2007, (9), pp. 290-294

152 Lester, J., Choudhury, T., and Borriello, G.: ‘A Practical Approach to Recognizing Physical Activities’. Proc. 6th International Conference on Pervasive Computing, Dublin, Republic of Ireland, 2006, Springer, pp. 1-16

153 Lin, J., J., Mamykina, L., Lindter, S., Delajoux, G., and Strub, H., B.: ‘Fish'n'Steps: Encouraging Physical Activity with an Interactive Computer Game’. Proc. 8th International Conference on Ubiquitous Computing, Portland, 2006, Springer, pp. 261-268

154 Lindley, S.E., Harper, R., and Sellen, A.: ‘Designing for Elders: Exploring the Complexity of Relationships in Later Life’. Proc. HCI, Liverpool, UK, 2008, BCS, pp. 77-88

155 Little, L., Storer, T., Briggs, P., and Duncan, I.: ‘E-Voting in an Ubicomp World’, Soc. Sci. Comput. Rev., 2008, 26, (1), pp. 44-59

156 Lofland, J., Snow, D., A., Anderson, L., and Lofland, L., H.: ‘Analyzing Social Settings: A Guide to Qualitative Observation and Analysis’ (Wadsworth Publishing, 2005)

157 Lukowicz, P., Hanser, F., Szubski, C., and Schobersberger, W.: ‘Detecting and Interpreting Muscle Activity with Wearable Force Sensors’. Proc. 6th International Conference on Pervasive Computing, Dublin, Republic of Ireland, 2006, Springer, pp. 101-116

158 Macefield, R.: ‘Usability Studies and the Hawthorne Effect’, Journal of Usability Studies, 2007, 2, (3), pp. 145-154

159 Maitland, J., Sherwood, S., Barkhuus, L., Anderson, I., Hall, M., Brown, B., Chalmers, M., and Muller, H.: ‘Increasing the Awareness of Daily Activity Levels with Pervasive Computing’. Proc. Pervasive Health, 2006, IEEE, pp. 1-9

160 Maitland, J., Siek, K., A., and Chalmers, M.: ‘Persuasion not Required: Improving our Understanding of the Sociotechnical Context of Dietary Behavioural Change ’. Proc. Pervasive Health, 2009, IEEE, p. 1-9

161 Maloney-Krichmar, D., and Preece, J.: ‘A multilevel analysis of sociability, usability, and community dynamics in an online health community’, ACM Trans. Comput.-Hum. Interact., 2005, 12, (2), pp. 201-232

162 Mamykina, L., Mynatt, E., D., and Kaufman, D., R.: ‘Investigating Health Management Practices of Individuals with Diabetes’. Proc. SIGCHI conference on Human Factors in computing systems, Montreal, Canada, 2006, ACM, pp. 927-936

163 Mamykina, L., Mynatt, E., Davidson, P., and Greenblatt, D.: ‘MAHI: investigation of social scaffolding for reflective thinking in diabetes management’. Proc. SIGCHI conference on Human factors in computing systems, Florence, Italy, 2008, ACM, pp. 371-376

164 Mankoff, J., Hsieh, G., Hung, H., C., Lee, S., and Nitao, E.: ‘Using Low-Cost Sensing to Support Nutritional Awareness’. Proc. 4th International Conference on Ubiquitous Computing, 2002, Springer, pp. 371-376

165 Marcuccio, E., Loving, N., Bennet, S.K., and Hayes, S.N.: ‘A survey of attitudes and experiences of women with heart disease’, Womens Health Issues, 2003, 13, (1), pp. 23-31

166 Marcus, B., H. , Lewis, B., A., Williams, D., M., Dunsiger, S., Jakicic, J., M. , Whiteley, J., A. , Albrecht, A., E. , Napolitano, M., A. , Bock, B., C. , Tate, D., F. , Sciamanna, C., N. , and Parisi, A., F. : ‘A comparison of Internet and print-based physical activity interventions.’, Archives of Internal Medicine, 2007, 167, (9), pp. 944-949

167 Maslow, A.,H.: A Theory of Human Motivation, Psychological Review 50(4) (1943):370-96.

168 Mattila, J., and Vaatanen, A.: 'UbiPlay: An interactive playground and visual programming tools for children'. Proc. IDC'06, Tampere, 2006, ACM, pp. 129-136

169 McLean, N., Griffin, S., Toney, K., and Hardeman, W.: 'Family involvement in weight control, weight maintenance and weight-loss interventions: a systematic review of randomized control trials.', International Journal of Obesity, 2003, 27, pp. 987-1005

170 McLean, S., and Timmins, F.: 'An exploration of the information needs of spouse/partner following acute myocardial infarction using focus group methodology', Nursing in Critical Care, 2007, 12, (3), pp. 141-150

171 McSweeney, B.: 'Hofstede's model of national cultural differences and their consequences: A triumph of faith - a failure of analysis', Human Relations, 2002, 55, pp. 89-118

172 Micco, N., Gold, B., Buzzell, P., Leonard, H., Pintauro, S., and J., H.-B.: 'Minimal in-person support as an adjunct to internet obesity treatment', Annals of Behavioral Medicine, 2007, 33, (1), pp. 49-56

173 Minkler, M.: ' Ethical Challenges for the "Outside" Researcher in Community-Based Participatory Research', Health Education Behaviour, 2004, 31, (6), pp. 684-697

174 Mokka, S., Vaatanen, A., Heinila, J., and Valkkynen, P.: 'Fitness Computer Game with a Bodily User Interface'. Proc. Proceedings of the second international conference on Entertainment computing, 38, 1-3, 2003

175 Moncur, W., Masthoff, J., and Reiter, E.: 'What Do You Want to Know? Investigating the Information Requirements of Patient Supporters'. Proc. 21st IEEE International Symposium on Computer-Based Medical Systems, 2008, IEEE, pp. 443-448

176 Mookadam, F., and Arthur, H.M.: 'Social support and its relationship to morbidity and mortality after acute myocardial infarction: systemic overview.', Archives of Internal Medicine, 2004, 164, (14), pp. 1514-1518

177 Moore, G.A.: 'Crossing the Chasm: Marketing and Selling Technology Products to Mainstream Customers' (Capstone, 2001)

178 Morris, F., and Choi, P.: 'Changing physical activity levels and exercise patterns', in Browning, C., J., and Thomas, S., A. (Eds.): 'Behavioural Change: An Evidence-based Handbook for Social and Public Health' (Elsevier Churchill Livingston, 2005), pp. 115-152

179 Mueller, F., and Agamanolis, S.: 'Sports over a distance', Comput. Entertain., 2005, 3, (3), pp. 4-4

180 Mueller, F., and Gibbs, M.: 'A table tennis game for three players'. Proc. 20th conference of the computer-human interaction special interest group of Australia on Computer-human interaction: design: activities, artefacts and environments, Sydney, Australia, 2006, ACM, pp. 321-324

181 Mutrie, N., and Choi, P.: 'Is 'fit' a feminist issue? Dilemmas for exercise psychology.', Feminism and Psychology, 2000, 10, (4), pp. 544-551

182 Nagel, K., S. , Hudson, J., M., and Abowd, G., D.: 'Predictors of availability in home life context-mediated communication'. Proc. Proceedings of the 2004 ACM conference on Computer supported cooperative work, Chicago, 2004

183 Nakamura, S., Minakuchi, M., and Tanaka, K.: 'Energy Browser: To Make Exercising Enjoyable and Interesting'. Proc. ACE, Valencia, Spain, 2005

184 National Cancer Institute: 'The Role of the Media in Promoting and Reducing Tobacco Use, Tobacco Control Monograph No. 19.' Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute. NIH Pub. No. 07-6242, June 2008

185 Neal, L., Oakley, K., Lindgaard, G., Kaufman, D., Leimeister, J.M., and Selker, T.: 'Online health communities. ', Proc. CHI '07 extended abstracts on Human factors in computing systems, 2007, ACM, 2129 - 2132

186 Ni Mhurchu, C., Margretts, B.M., and Speller, V.M.: ' Applying the stages-of-change model to dietary change. ', Nutrition Reviews, 2007, 55, pp. 10-16

187 Niaura, R.: 'Nonpharmacological Therapy for Smoking Cessation: Characteristics and Efficacy of Current Approaches', The American Journal of Medicine, 2008, 121, (4), pp. S11-S19

188 OBrien, C.S.: 'Grounding theory in self-referent thinking: Conceptualizing motivation for older adult physical activity ', Psychology of Sport and Exercise, 2003, 4

189 Ogilvie, D., and Hamlet, N.: 'Obesity: the elephant in the corner', BMJ, 2005, 331, pp. 1545-1548

190 Parliamentary Office of Science and Technology: 'Health Behaviour', Postnote, 2007

191 Peters, M.J.: 'Should smokers be refused surgery?', BMJ, 2007, 334, (20)

192 Pivarnik, J.M., Reeves, M.H., and Rafferty, A.P.: 'Seasonal Variation in Adult Leisure-Time Physical Activity', Med & Sci in Sp & Exer, 2003, pp. 1004-1008

193 Plante, T.G., Aldrige, A., Bogden, R., and Hanelin, C.: 'Might virtual reality promote the mood benefits of exercise?', Computers in Human Behavior, 2003, 19, pp. 495-509

194 Polzien K., M., Jakicic J., M., Tate D., F., and Otto A., D.: 'The efficacy of a technology-based system in a short-term behavioral weight loss intervention', Obesity, 2007, 15, (4), pp. 825-830

195 Porrit, D.: 'Social support in crisis. Quantity or quality?', Social Science and Medicine, 1979, 13A, pp. 715-721

196 Preece, J., Nonnecke, B., and Andrews, D.: 'The top five reasons for lurking: Improving community experiences for everyone', Computers in Human Behavior, 2004, 20, (2), pp. 201-223

197 Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., and Carey, T.: 'Human-Computer Interaction' (Addison-Wesley, 2000)

198 President' s Council on Physical Fitness and Sports: 'Walking Works: The Blue Program for a Healthier America', 2004

199 Prochaska, J., and DiClemente, C.: 'Transtheoretical therapy: toward a more integrative model of change.', Journal of Consulting and Clinical Behaviour, 1982, 51, pp. 390-395

200 Prochaska, J., Velecier, W., F., Rossie, J., F., Goldstein, M., G., Marcus, B., H., and Rakowski, W.: 'Stages of Change and decisional Balance for 12 Problem Behaviours', Health Psychology, 1994, 13, (1), pp. 39-46

201 Putnam, R.: 'Bowling Alone: America's Declining Social Capital', Journal of Democracy, 1995, 6, pp. 65-78

202 Rabinovitch, N.: 'Smoky, and they banned it! Lessons learned from smoking bands and their effects on public health', Journal of Allergy and Clinical Immunology, 2008, 122, (3), pp. 542-543

203 Razavi, M., N., and Iverson, L.: 'A Grounded Theory of Information Sharing Behaviour in a Personal Learning Space'. Proc. 2006 ACM conference on Computer supported cooperative work, Banff, Canada, 2006, ACM, pp. 459 - 468

204 Reed, J., Frazao, E., and Itskowitz, R.: 'How Much Do Americans Pay for Fruits and Vegetables?', 2004, USDA Research Service

205 Rice, B.: 'The Hawthorne defect: Persistence of a flawed theory', Psychology Today, 1982, 16, (2), pp. 70-74

206 Rogers, T.B., Kuiper, N.A., and Kirker, W.S.: 'Self-reference and the encoding of personal information', Journal of Personal and Social Psychology, 1977, 35, pp. 677-688

207 Rogers, Y.: 'Moving on from Weiser's Vision of Calm Computing: Engaging UbiComp Experiences'. Proc. 8th International Conference on Ubiquitous Computing, 2006, Springer, pp. 404-421

208 Rojot, J.: 'Negotiation: From Theory to Practice' (Macmillan, 1991)

209 Rollnick, S., Heather, N., Gold, R., and Hall, W.: 'Negotiating behaviour change in medical settings: the development of brief motivational interviewing', Journal of Mental Health, 1992, 1, pp. 25-37

210 Rosenstock, I.M., Strecher, V.J., and Becker, M.H.: 'Social learning theory and the health belief model', Health Education Quarterly, 1988, 15, pp. 175-183

211 Sallis, J.F., and Sealens, B.E.: 'Assessment of Physical Activity by Self-Report: Status, Limitations, and Future Directions', Research Quarterly for Exercise and Sport, 2001, 71, pp. S1-14

212 Schofield, L., Mummery, W.K., and Schofield, G.: 'Effects of a controlled pedometer-intervention trial for low-active adolescent girls ', Med & Sci in Sp & Exer, 2005, 37, pp. 1414-1420

213 Schulman, D., and Bickmore, T.: 'Persuading Users through Counseling Dialogue with a Conversational Agent', Proc. Persuasive, Oulu, Finland, Springer, 2009

214 Seeman, T.E., and Syme, S.L.: 'Social networks and coronary artery disease: A comparison of the structure and function of social relations as predictors of disease', Psychosomatic Medicine, 1987, 49, pp. 341-354

215 Shapiro, D.: 'The limits of ethnography: combining social sciences for CSCW'. Proc. 1994 ACM conference on Computer supported cooperative work, Chapel Hill, North Carolina, 1994, ACM, pp. 417-428

216 Sharrock, W., and Hughes, J.A.: 'Ethnography in the workplace: Remarks on its theoretical bases', Team Ethno, 2001, 1, (1), pp.1

217 Shaw, J., and Baker, M.: 'Expert patient: dream or nightmare?', BMJ, 2004, 328, pp. 723-724

218 Shen, B.J., Myers, H.F., and McCreary, C.P.: 'Psychosocial predictors of cardiac rehabilitation quality-of-life outcomes', Journal of Psychosomatic Research, 2006, 60, (1), pp. 3-11

219 Sherif, K., Hoffman, J., and Thomas, B.: 'Can technology build organizational social capital?: the case of a global IT consulting firm', Inf. Manage., 2006, 43, (7), pp. 795-804

220 Sherwood, S.: 'Designing for impression management', Unpublished Thesis, University of Glasgow, 2009 http://dolak.dcs.gla.ac.uk/scott/Site%203/thesis.pdf [last accessed 27/5/09]

221 Siebert, S.: 'New generation active computer games in osteoarthritis', BMJ Rapid Resposnse to Graves[113] http://www.bmj.com/cgi/eletters/335/7633/1282#184568 [last accessed 28/2/09], 2007

222 Smedberg, A.: 'How to Combine the Online Community with Ask the Expert Systems in a Health Care Site'. Proc. ICDS, 2007, IEEE, pp.15

223 Smith, B.K., Frost, J., Albayrak, M., and Sudhakar, R.: 'Integrating glucometers and digital photography as experience capture tools to enhance patient understanding and communication of diabetes self-management practices', Personal and Ubiquitous Computing, 2007, 11, (4), pp. 273-286

224 Smith, M.S.: 'Social capital in online communities'. Proc. Proceeding of the 2nd PhD workshop on Information and knowledge management, Napa Valley, California, 2008, ACM, pp. 17-24

225 Smith, R.B., Hixon, R., and Horan, B.: 'Supporting flexible roles in a shared space'. Proc. 1998 ACM conference on Computer supported cooperative work, Seattle, Washington, 1998, ACM, pp. 197-206

226 Southard, B.S., Southard, D.R., and Nuckolis, J.: 'Clinical Trial of an Internet-based Case Management System for Secondary Prevention of Heart Disease', Journal of Cardiopulmonary Rehabilitation, 2003, 23, (5), pp. 341-348

227 Speck, B., J., and Harrel, J.S.: 'Maintaining Regular Physical Activity in Women - Evidence to Date', Journal of Cardiovascular Nursing, 2003, 18, (4), pp. 282-291

228 Speck, B., J., and Looney, S., W.: 'Effects of a Minimal Intervention to Increase Physical Activity in Women – Daily Activity Records.', Nursing Research., 2001, 50, (6), pp. 374-378

229 Stinson, K.M.: 'Women and dieting culture: inside a commercial weight loss group' (Rutgers University Press, 2001)

230 Strauss, A., and Corbin, J.: 'Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory' (Sage, 1998)

231 Strecher, V.J., Seijts, G.H., Kok, G.J., Latham, G.P., Glasgow, R., DeVellis, B., Meertens, R.M., and Bulger, D.W.: 'Goal Setting as a Strategy for Health Behavior Change ', Health Education Behaviour, 1995, 22, pp. 190-200

232 Strong, K., Mathers, C., Epping-Jordan, J., and Beaglehole, R.: 'Preventing chronic disease: a priority for global health', International Journal of Epidemiology, 2006, 35, (2), pp. 492-494

233 Sullivan, G.B., and Sullivan, M.J.: 'Promoting wellness in cardiac rehabilitation: exploring the role of altruism', Journal of Cardiovascular Nursing, 1997, 11, (3), pp. 43-52

234 Sundararaman, K., Parthasarathi, J., Rao, S., and Rao, A.: 'Hridaya: A tele-medicine initiative for cardiovascular disease through convergence of grid, web 2.0 and SaaS'. Proc. Pervasive Health, 2008, IEEE, pp. 15-18

235 Tate, D., F., Wing, R., R., and Winett, R., A.: 'Using Internet technology to deliver a behavioral weight loss program', JAMA, 2001, 285, (9), pp. 1172-1177

236 Thompson, D., Baranowski, J., Cullen, K., and Baranowski, T.: 'Development of a theory-based internet program promoting maintenance of diet and activity change to 8-year-old African American girls', Computers & Education, 2007, 48, pp. 446-459

237 Toscos, T., Faber, A., An, S., and Gandhi, M.P.: 'Chick clique: persuasive technology to motivate teenage girls to exercise'. Proc. CHI '06 extended abstracts on Human factors in computing systems, Montreal, Canada, 2006, ACM, pp. 1873-1878

238 Toscos, T., Faber, A.M., Connelly, K.H., and Upoma, A.M.: 'Encouraging Physical Activity in Teens: Can technology help reducte barriers to physical activity in adolescent girls?'. Proc. Pervasive Health, 2008, IEEE, pp. 173-184

239 Tsai, A., G., and Wadden, T.A.: 'Systematic Review: An Evaluation of Major Commercial Weight Loss Programs in the United States', Annals of Internal Medicine, 2005, 142, (1), pp. 56-66

240 Tsai, C., C., Lee, G., Raab, F., Norman, G., J., Sohn, T., Griswold, W., G., and Patrick, K.: 'Usability and feasibility of PmEB: a mobile phone application for monitoring real time caloric balance', Mobile Networks and Applications, 2007, 12, (2-3), Springer, pp. 173-184

241 Tudor-Locke, C., E., Myers, A., M., Bell, R., C., Harris, S., B., and Rodger, W.: 'Preliminary outcome evaluation of the First Step Program: a daily physical activity intervention for individuals with type 2 diabetes', Patient Education and Counselling, 2002, 41, (1), pp. 23-28

242 Turner, J., C.: 'Social Influence' (Open University Press, 1991)

243 Tyler, D.O., and Horner, S.D.: 'Family-centred collaborative negotiation: A model for facilitating behavior change in primary care', Journal of the American Academy of Nurse Practitioners, 2008, 20, pp. 194-203

244 Vaidhyananthan, S.: 'Generational Myth: Not all young people are tech-savvy', The Chronical of Higher Education: The Chronical Review, 2008, 55, (4), pp. B7

245 van den Berg M., H., Schoones J., W., and Vliet Vlieland T., P., M.: 'Internet-Based Physical Activity Interventions: A Systematic Review of the Literature', J Med Internet Res 2007, 9, (3), pp. e26

246 Verheijden, M.W., Bakx, J.C., van Weel, C., Koelen, M.A., and van Straveren, W.M.: 'Role of social support in lifestyle-focused weight management interventions', European Journal of Clinical Nutrition, 2005, 59, (1), pp. 179-186

247 Wallerstein, N.: 'Powerlessness, empowerment and health: implications for health promotion programs', American Journal of Health Promotion, 1992, 6, (3), pp. 197-205

248 Walter, C.: 'Community building practice.', in Minkler, M. (Ed.): 'Community Organizing and Community Building to Improve Health. ' (Rutgers University Press, 1997)

249 Wanless, D.: 'Securing Good Health for the Whole Population', 2004

250 Weiser, M.: 'The Computer for the Twenty-First Century', Scientific American, 1991

251 White, M., and Dorman, S.M.: 'Receiving social support online: implications for health education', Health Education Research, 2001, 16, (6), pp. 693-707

http://www.who.int/dietphysicalactivity/publications/facts/pa/en/ [last accessed 20/2/09], 2006

252 Williamson, D.A., and Stewart, T.M.: 'Behavior and lifestyle: approaches to the treatment of obesity', Journal of the Louisiana State Medical Society, 2005, 157, (Spec No 1), pp. S50-S55

253 Winett, R., A., Anderson, E., S., and Wojcik, J., R.: 'Guide to Health: Nutrition and Physical Activity Outcomes of a Group-Randomized Trial of an Internet-Based Intervention in Churches', Annals of Behavioral Medicine, 2007, 33, (3), pp. 251-61

254 Wing, R., R., Tate, D., F., Raynor, A., A., Fava, H., A., and Joseph, L.: 'A self-regulation program for maintenance of weight-loss', New England Journal of Medicine, 2006, 355, (15), pp. 1563-1571

255 Wingham, J., Dalal, H.M., Sweeney, K.G., and Evans, P.H.: 'Listening to patients: choice in cardiac rehabilitation.', European Journal of Cardiovascular Nursing., 2006, 5, (4), pp. 289-294

256 World Health Organisation: 'Ottawa Charter for Health Promotion', 1986

257 World Health Organisation: 'Chronic disease risk factors', 2003

258 World Health Organisation, 'Physical Activity', 2006

259 Zajonc, R.B.: 'Social Facilitation: A solution is suggested for an old unresolved psychological problem', Science, 1965, 149, pp. 269-274

260 Zigelbaum, J., Millner, A., Desai, B., and Ishii, H.: 'BodyBeats: Whole-Body, Musical Interfaces for Children'. Proc. CHI '06 extended abstracts on Human factors in computing systems, Montreal, Canada, 2006, ACM, pp. 1595-1600

261 Zutz, A., Ignaszewski, A., Bates, J., and Lear, S.A.: 'Utilization of the internet to deliver cardiac rehabilitation at a distance: a pilot study', Telemedicine and e-Health, 2007, 13, (3), pp. 323-330